NSTS 07700, Volume XIV,

Appendix 5

System Description and Design Data -

Ground Operations

DESCRIPTION OF CHANGES TO

SYSTEM DESCRIPTION AND DESIGN DATA - GROUND OPERATIONS
NSTS 07700, VOLUME XIV, APPENDIX 5

CHANGE NO.	DESCRIPTION/AUTHORITY	DATE	PAGES AFFECTED
REV J	Complete revision; replaces and supersedes ground operations sections to Revision I of NSTS 07700, Volume XIV (reference CR D07700-014-005-00). The following CR's are included: D07700-014-005-01, D07700-014-005-02, D07700-014-005-03, D07700-014-005-04, D07700-014-005-05, D07700-014-005-06, D07700-014-005-07, D07700-014-005-08, D07700-014-005-09, D07700-014-005-10, D07700-014-005-11, D07700-014-005-12, D07700-014-005-13, D07700-014-005-14, D07700-014-005-15, D07700-014-005-16, D07700-014-005-17, D07700-014-005-18, D07700-014-005-19, D07700-014-005-20, D07700-014-005-21.	2/23/88	ALL
1	The following CR's are included: D07700-014-005-26, D07700-014-005-28.	6/14/89	Figure 1, vi, 12-8 through 12-12
2	The following CR's are included: D07700-014-005-29, D07700-014-005-30.	12/1/89	2-2, 9-2, 9-3, 14-1
REV K	Complete revision; the following CR's are included: D07700-014-005-31A, D07700-014-005-32, D07700-014-005-33, D07700-014-005-34.	7/31/91	ALL
1	The following CR's are included: D07700-014-005-35, D07700-014-005-36A, D07700-014-005-37	12/16/92	2-2, 2-3, 3-10, 4-8, 7-3, 8-1, 8-2
2	The following CRs are included: D07700-014-005-038, D07700-014-005-041, D07700-014-005-042	10/28/94	2-2, 4-12, 7-2
	Reformat Word for Windows.	7/96	ALL
3	The following CR is included: D07700-014-005-043	04/23/96	2-2
4	The following CR is included: D07700-014-005-0044	11/25/96	4-7, 8-1, 8-2
5	The following PRCBD is included: S061095	06/29/98	7-4

DESCRIPTION OF CHANGES TO

SYSTEM DESCRIPTION AND DESIGN DATA - GROUND OPERATIONS
NSTS 07700, VOLUME XIV, APPENDIX 5

CHANGE NO.	DESCRIPTION/AUTHORITY	DATE	PAGES AFFECTED
6	The following PRCBD is included: S061351	07/18/00	v
7	The following CR is included: D07700-014-005-0048	03/20/91	2-2
8	The following CR is included: D07700-014-005-0049	07/16/01	vi, 10-5, 10-6, 10-7, 10-8, 10-9, 10-10, 10-11, 10-12, 10-13
REV L	Complete revision; the following CR is included D07700-014-05-050	08/02/02	ALL

Preface

This document is designed to be used in conjunction with the series of documents illustrated in Figure 1. Information explaining the technical basis for Space Shuttle Program (SSP) launch and landing ground operations accommodations and capabilities is presented herein.

Specific agreements for ground services must be specified in the individual payload integration plans.

Effective with the publication of this revision, configuration control of this document will be accomplished through the application of the procedures contained in NSTS 07700, Vol. IV, Configuration Management Requirements, current issue.

Questions and recommendations concerning this document should be addressed to:

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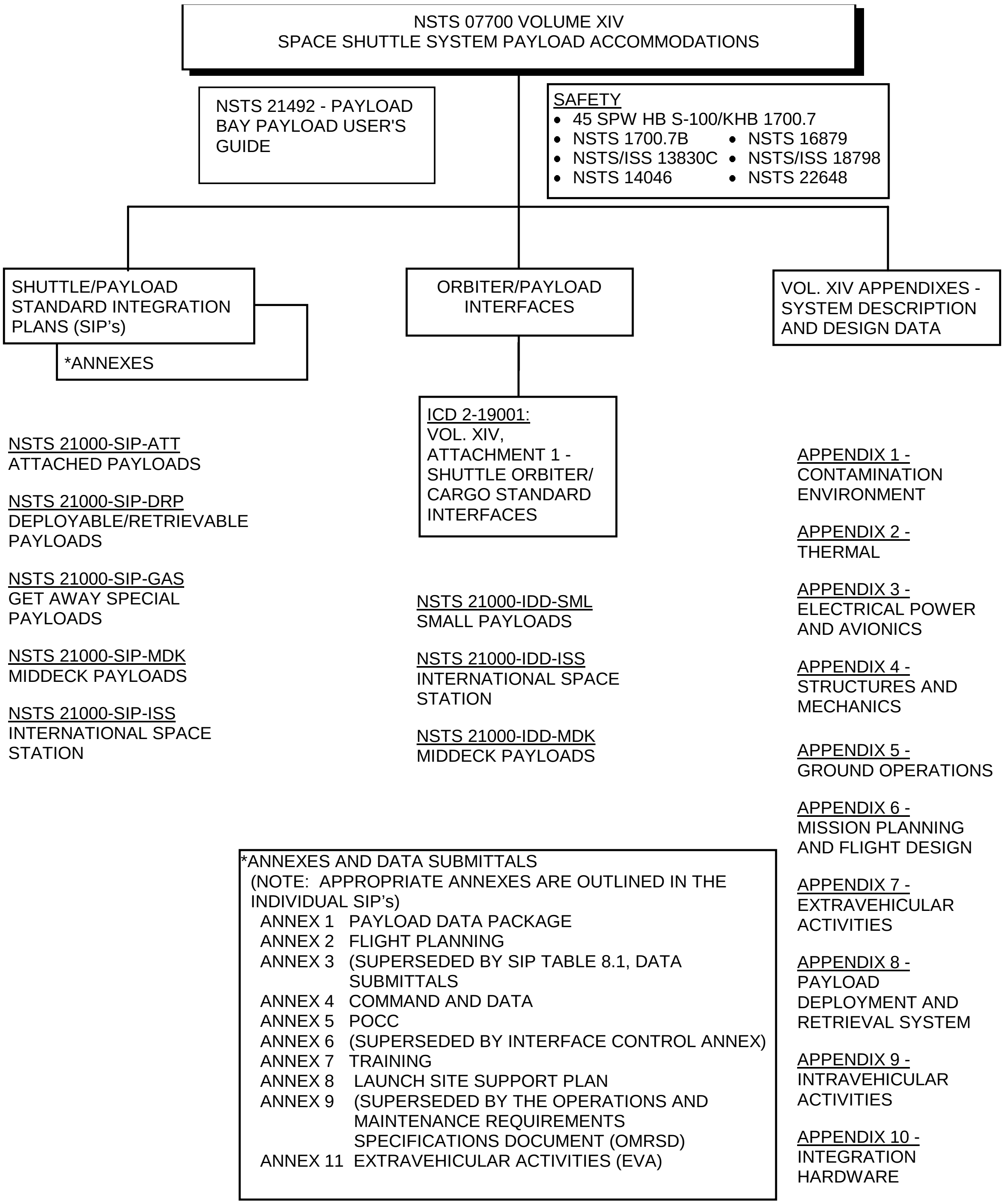

Figure 1.- Space Shuttle Program customer documentation tree.

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Tables

Figures

Space Shuttle Program Payload Integrated Ground Operations

1

1.1 General

The Space Shuttle Program (SSP) Director levies the following requirements upon the payload customer pertaining to ground operations. Payload interface verification requirements for the Space Shuttle are defined in Payload Verification Requirements, NSTS 14046. Payload performance testing and payload system checkout are required prior to installation. Payload checkout in Space Shuttle facilities and on the launch pad will be minimized and physical access to the payload will be limited. Payload operations at the launch site will comply with both Safety Policy and Requirements for Payloads Using the Space Transportation System, NSTS 1700.7B, and Space Transportation System Payload Ground Safety Handbook, 45SW HB S-100/KHB 1700.7.

SSP ground processing logic flow at the launch site is shown in Figure 12-1. This logic flow will assist the reader in understanding this document as well as operations at the launch site. Operations depicted in the flow will vary depending on the applicable flow path. In general, a payload may flow through the launch site to the Space Shuttle vehicle (Figure 1-1) in a horizontal mode (Figure 1-2), or in a vertical mode (Figure 1-3). At the launch site a launch site support manager (LSSM) is assigned to each payload and is the primary contact for customer launch site processing.

1.2 Preflight Decision Planning

The customer is required to support a preflight decision process to define, to the maximum extent possible, responses to off-nominal situations that may be encountered in a real-time environment during the launch countdown. The customer identifies alternate plans or courses of action including: (1) GO/NO-GO criteria for specific launch countdown phases; (2) launch window expansion options; (3) payload operations priorities; and (4) postflight management of payload systems for off-nominal conditions. The purpose is to minimize the amount of real-time rationalization required. Payload decision points and agreements, including necessary procedures, will be identified prior to countdown operations.

1.3 Shuttle/Payload Turnaround Ground Rules

The following ground rules apply to the Shuttle flow task at SSP launch and landing sites.

a. Standard timeline and sequenced flows for payload-related functions are applicable to all payloads and/or flights. The launch minus (L-) clock indicates actual time remaining until liftoff. Payload-related operations that include opening the payload bay doors after hypergolic servicing must be identified very early in the planning process. Servicing will be completed prior to L-84 hours in preparation for the launch countdown unless specifically agreed to by launch site management. If a payload requires access extending into launch countdown procedural sequences (which begin at L-76 hours), additional coordination with the launch director is required. In no case will such access extend beyond L-60 hours. These requirements for late access will require unique Shuttle operational scheduling as negotiated and agreed to in the integration plan (IP). Unplanned events involving late payload bay door openings may result in launch postponement by the SSP until the next available opportunity to avoid compromising the prelaunch flow baselined for the mission.

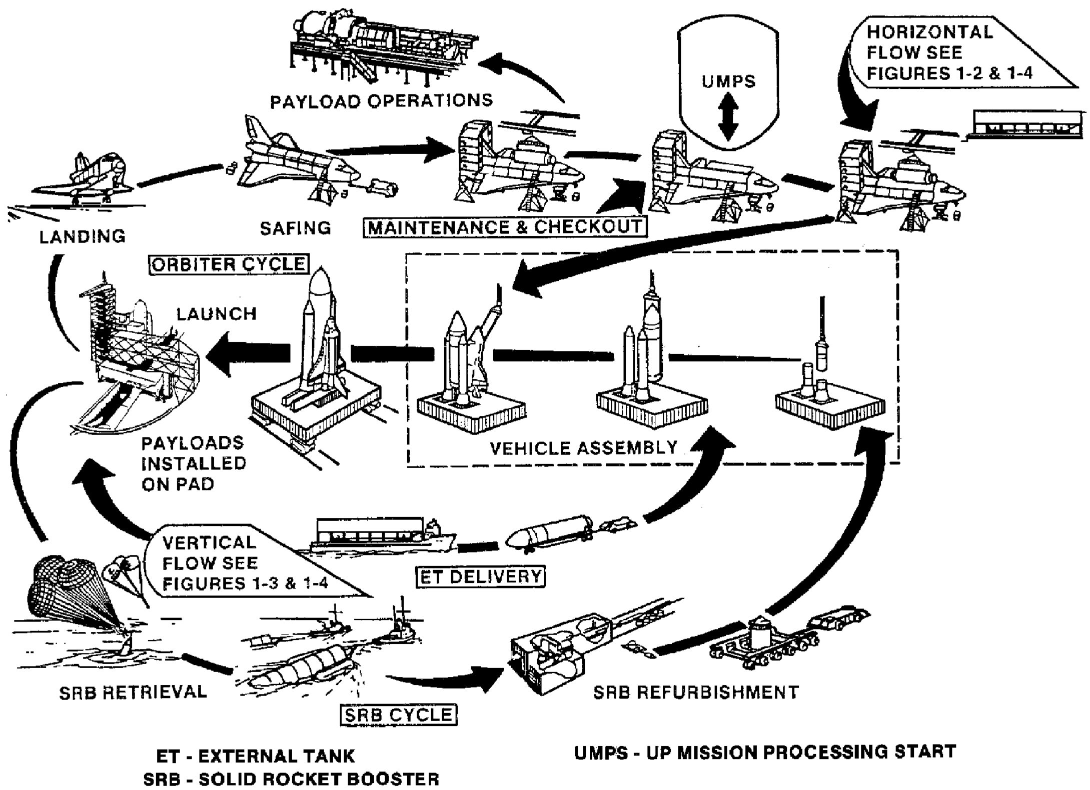


Figure 1-1.- KSC Space Shuttle ground operations.

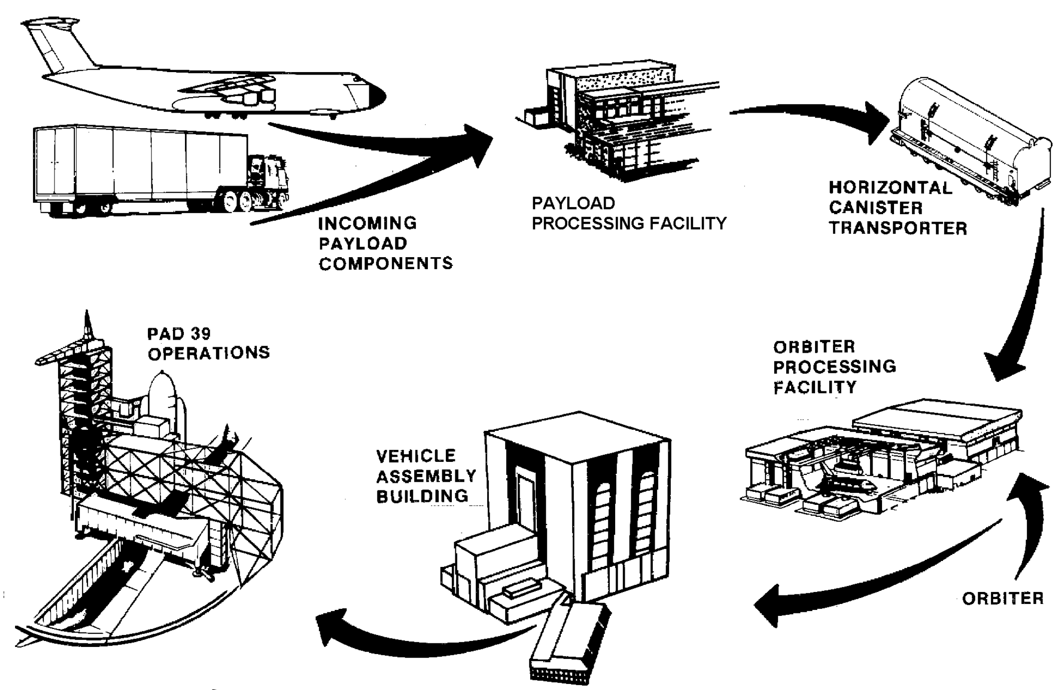


Figure 1-2.- KSC pictorial flow for horizontal payload processing.

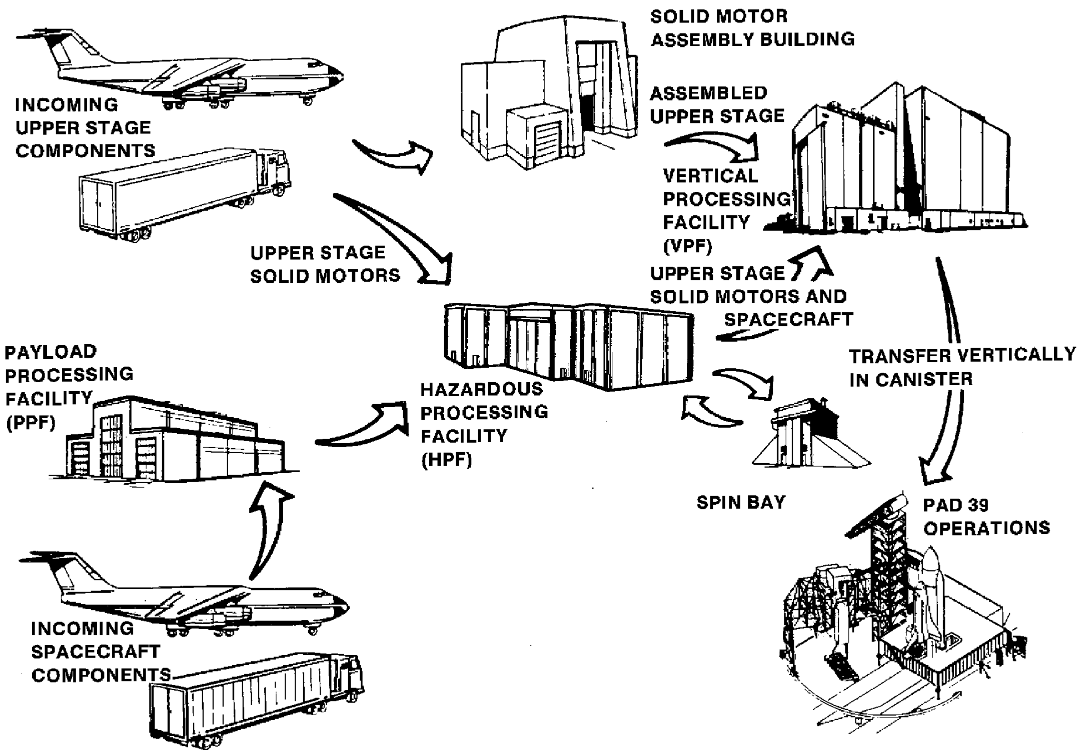


Figure 1-3.- KSC pictorial flow for vertical payload processing.

b. John F. Kennedy Space Center (KSC) Shuttle non-pad ground operations and Orbiter internal systems providing services to payloads will be available on a two-shift-per-day, 5-days-per-week (non-holiday) personnel work schedule. All flight systems except payload bay purge will be off during nonworking hours. Launch pad operations will be performed on a three-shift-per-day, as scheduled basis.

c. All payload and Space Shuttle payload-peculiar integration equipment will be checked out prior to interfacing with SSP flight and ground systems. These tests will be performed in the Space Shuttle/payload interface verification equipment test stands.

The National Aeronautics and Space Administration (NASA) will define the appropriate flow for the payload as a function of interface complexity and/or previous experience with similar payloads. The resulting decision will be documented in the Launch Site Support Plan, IP Annex 8.

d. Fluid, electrical, and electronic services provided to the payload by ground support equipment (GSE) through the time minus zero (T-0) launch and midbody umbilical panels are addressed in section 3 of Shuttle Orbiter/Cargo Standard Interfaces, ICD 2-19001.

e. Payload removal and installation capability exists in the Orbiter Processing Facility (OPF) for horizontal mode. Vertical processing installation occurs at the launch pad. Vertical processing removal is accomplished in the OPF with the Orbiter in a horizontal position, following landing.

f. Security of Department of Defense (DOD) payloads and associated support equipment will be maintained throughout ground turnaround operations.

g. Facility standard interfaces for mechanical, fluid, electrical and electronic services are provided to the payload as defined in the documents listed in Table 1-I.

h. Standard level of cleaning as discussed in Section 8.0. Level of cleanliness is documented in payload-specific IP.

Table 1-I.- SPACE SHUTTLE FACILITIES DESCRIBED IN STANDARD INTERFACE DOCUMENTS

FACILITY	STANDARD INTERFACE DOCUMENT #
Orbiter Processing Facility	79K18745
PAD 39A, Mobile Launch Platform 10A	79K18218
PAD 39B, Mobile Launch Platform 10A	79K28802
Vertical Processing Facility	79K16210
Horizontal Processing Facility (HPF)	79K16211
Payload/Ground Transport Canister	79K12170
Payload Strongback	79K17644
Payload Environmental Transportation System Multiuse Container (PETS)	82K00463
Space Station Processing Facility (SSPF)	82K00760
Multi-Payload Processing Facility (MPPF)	82K05979
Payload Hazardous Servicing Facility (PHSF)	82K03223

Up Mission Processing Operations

2

2.1 General

Orbiter up mission processing start (UMPS) is defined as the point when an Orbiter has been deconfigured from the previous mission and reconfiguration starts for the current mission. The up mission processing for a flow begins at the SSP UMPS Level II milestone and ends with solid rocket booster (SRB) ignition. Normal end of mission (EOM) and abort operations are addressed in subsection 7.5, Postlanding Operations.

The mission Launch Site Flow Review (LSFR) is held approximately 6 weeks prior to UMPS by the SSP to establish Space Shuttle readiness and launch site preparation. If both are acceptable to the SSP, mission flow processing will begin. UMPS will mark the start of Orbiter online activities for a particular payload mission regardless of the hardware flow approach used. Several weeks prior to UMPS, payload preinstallation activity begins as scheduled. As these two activities proceed in parallel, the SSP and payload customers jointly participate in a launch site Payload Readiness Review (PRR) to establish the readiness of each element. After the PRR, installation of the payload into the Orbiter typically occurs within 1 week.

2.2 Horizontally Installed Payloads

Launch pad access to horizontally installed payloads is not normally planned (note 1). The Orbiter vehicle and ground facilities provide access capability to the payload (note 3).

Note 1. Payload bay doors are nominally closed for horizontally installed payloads no later than L-40 days, and payload bay door access to the payload typically will not be available after that time. Access could be unavailable for an accumulated time of 47 days, as follows:

- 7 days - payload bay door closure and Orbiter preparations for rollout from the OPF
- 7 days - Vehicle Assembly Building (VAB) operations
- 26 days - pad operations
- 3 days - weather/equipment holds
- 96 hours launch window (i.e., 4 launch attempts).

2.3 Vertically Installed Payloads

The Orbiter vehicle and ground facilities provide access to the payload through the payload bay doors (Notes 2 and 3). In order to maintain the scheduled liftoff, payload late access must end by L-60 hours. To facilitate launch countdown, payloads should terminate access before the start of the launch countdown at L-72 hours (nominal).

Note 2. When a payload does not require access after the payload bay doors are closed, access may not be provided for an accumulated time of up to 26 days, as follows:

- L-19 days - payload bay door closure for hypergolic servicing
- 3 days - weather/equipment holds
- 96 hours + launch window (i.e., four launch attempts)

Note 3. Payloads which require late access to the payload bay after hypergolic servicing to complete payload servicing must identify this requirement early in the payload integration planning process. Payload servicing may include, but is not limited to:

- Topping-off expendable commodities
- Battery charging or installation
- Closeouts/cover removals
- Limited-life hardware or scientific sample installation
- Time-critical testing

These requirements increase pad timelines and launch countdown preparations, but access must be terminated at L-60 hours to maintain an on-time liftoff. Any equipment used for access or servicing through the payload bay doors shall be designed to facilitate payload bay door closure within 4 hours for severe weather condition predictions and safing.

2.4 Middeck Payloads

Access shall be provided for payloads in the middeck through the Orbiter crew compartment hatch for installation, interface verification testing, and removal. These payloads will normally be installed prior to the start of the launch countdown. Payloads that have an envelope exceedance to the NSTS 21000-IDD-MDK dimensions (Y or Z axis), double-size payloads in previously unused locations, or payloads that have new Orbiter interfaces should be fit checked in the Orbiter crew compartment in their manifested location. The requirement for a fit check will be determined by SSP, KSC, and payload representatives and documented in NSTS 08171, Operations and Maintenance Requirements and Specifications Document (OMRSD).

Late turnover of payloads in the middeck during the launch countdown must be identified early in the payload integration process. Four powered middeck payloads that require an Interface Verification Test (IVT) may be accommodated per mission for late turnover within launch minus 28 hours (L-28 hr). Additional middeck payloads that require an IVT, may be manifested following evaluation by the Launch Countdown Working Group and the approval of the Flight Manager. Late turnover will be scheduled and integrated with flightcrew equipment stowage activities to preclude a Space Shuttle serial time impact. Installation will be completed 16 hours prior to launch (17 hours 30 minutes prior to launch for missions with a short launch window), and will not interfere with crew pre-ingress switch list. Exceptions to the late turnover timeline must be documented in the appropriate IP and must be integrated with other countdown activities and payloads on a mission-specific basis by the Launch Countdown Working Group. Payload installation into the middeck will not prevent the launch countdown from proceeding to the primary mission planned launch window. Detailed turnover timelines and schedules will be developed by the Launch Countdown Working Group to ensure that countdown constraints can be met. However, if turnover cannot be accomplished within the scheduled turnover time, the SSP may decide to not install the middeck payload or to fly it in a nonoperational mode.

Requirements are documented in the Time Critical Ground Handling Requirements (TGHR) Table. Launch delays are discussed in section 6.4. Postlanding operations are discussed in section 7.0

2.5 Contingency Orbiter Rollback

In the event of certain contingencies (such as hurricanes), the Orbiter vehicle, with the payload in the payload bay, may be rolled back from the pad to the VAB and later returned for launch. If the payload is at the pad but not installed in the Orbiter, if time permits, the payload will be installed in the vehicle; and if time does not permit, the payload will be returned in the canister to SSPF airlock. For rollback, all access platforms are removed and drag-on cables are disconnected. The payload bay doors cannot be opened in the VAB, and there is no access to the payload bay. At the SSPF and MPPF, payloads will be covered with approved film and secured. Environmental controls will be maintained on a best-effort basis. Any payload-unique requirements shall be documented by the customer in IP Annex 8 and in the OMRSD.

Horizontal Payload Flow Processing

3

3.1 Orbiter Processing Facility Support Services

Figures 3-1 and 3-2 illustrate horizontal processing in the OPF.

Orbiter Processing Facility Standard Interface Document, Kennedy Space Center, 79K18745, details the facility support capabilities.

Personnel access through open payload bay doors and the middeck will be provided. Access GSE from the Orbiter access platforms to the Orbiter/ payload interface connections to support payload installation will be provided by the Shuttle ground system. Unique payload access equipment from Orbiter access platforms to payload equipment will be provided by the customer or SSP.

The OPF is environmentally controlled as a class 100,000 clean work area (CWA). Input air is controlled at 71 ± 6 degrees F (21.7 ± 3.3 degrees C) and 55 percent relative humidity (maximum).

Payload environmental conditioning and protection exceeding these capabilities shall be provided by the payload customer.

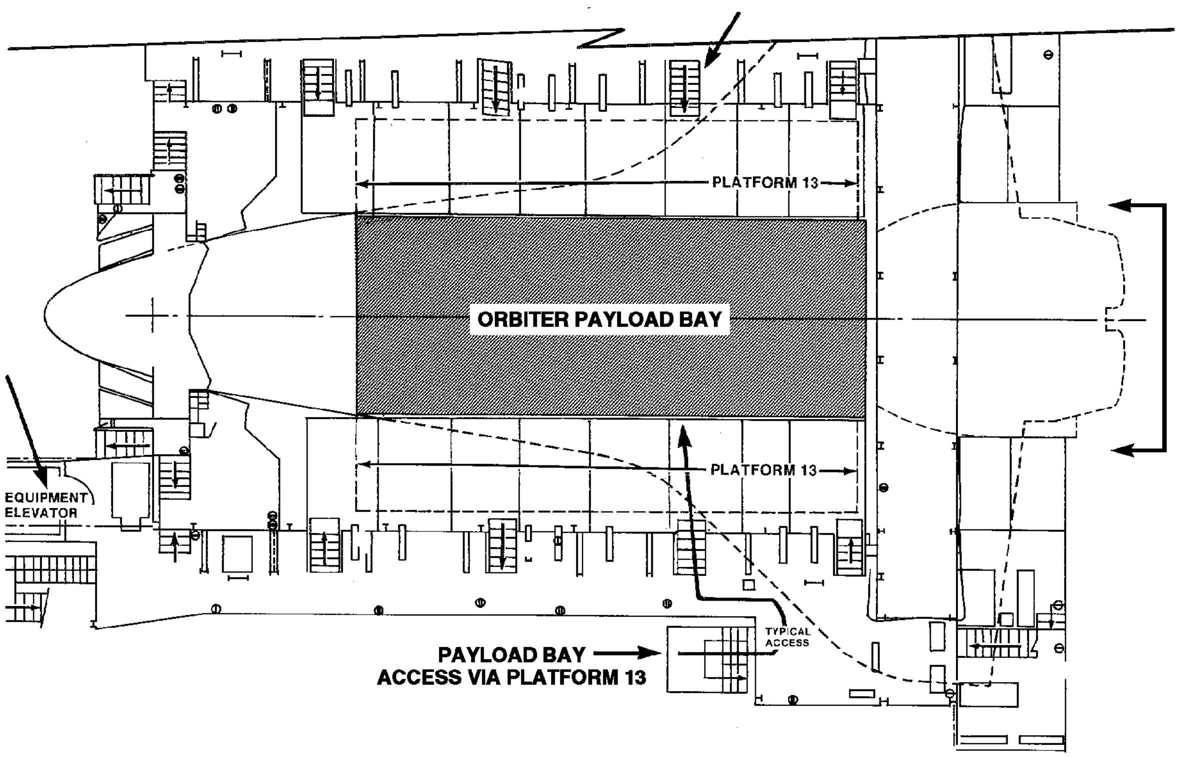
Floor space is provided for the payload strongback/canister/transporter during payload installation and removal, and also for payload test, checkout and servicing GSE.

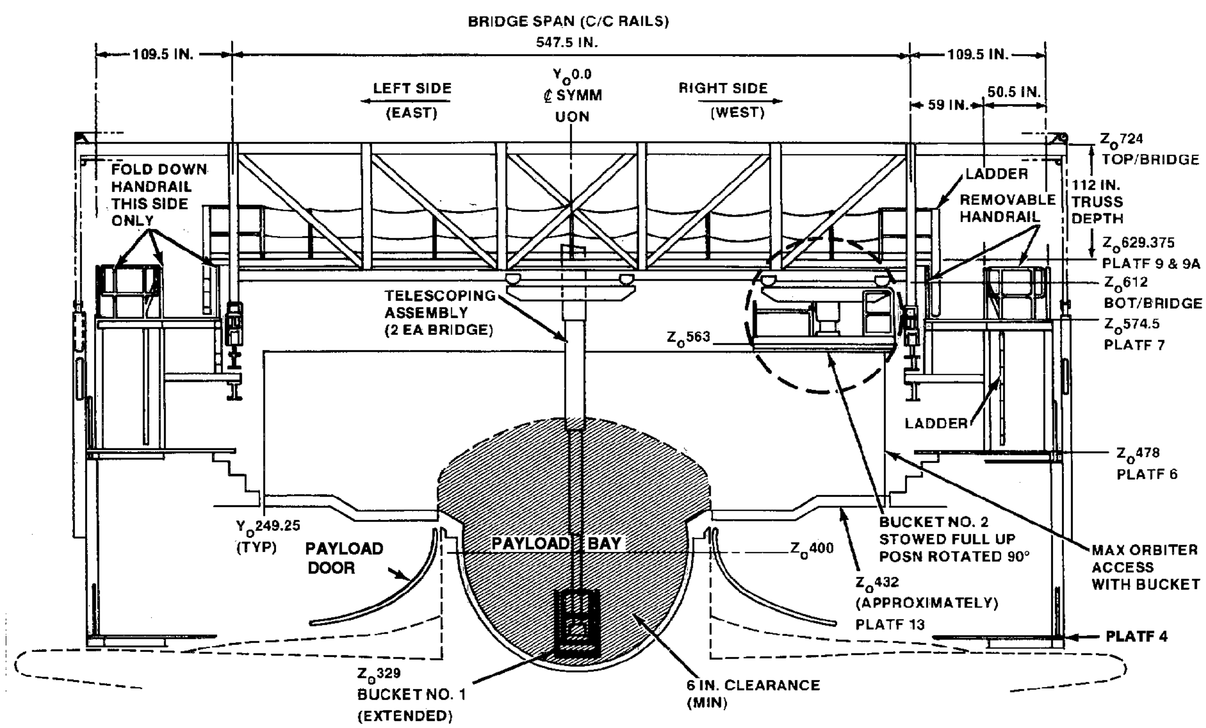
Hoisting GSE is provided for handling strongbacks plus payloads weighing up to 65,000 pounds (29,483.5 kg) maximum and with dimensions up to 15 feet (4.57 m) in diameter and 60 feet (18.29 m) in length.

Facility power is provided for payloads as follows:

- 120 V, 60 Hz, single phase alternating current (commercial quality power)
- 120/208 V, 60 Hz, 3-phase alternating current
- 120/208 V, 400 Hz, 3-phase alternating current
- Facility gases are provided for payloads as follows:
- Gaseous nitrogen (GN_2) - 3000 psig to payload service panel
- Gaseous helium (GHe) - 3000 psig to payload service panel
- Air - 125 psig compressed shop air with return exhaust

Other fluids and gases required by payloads will be furnished by the payload customer.





BRIDGE BUCKET ELEVATION

Figure 3-1.- OPF payload bay access.

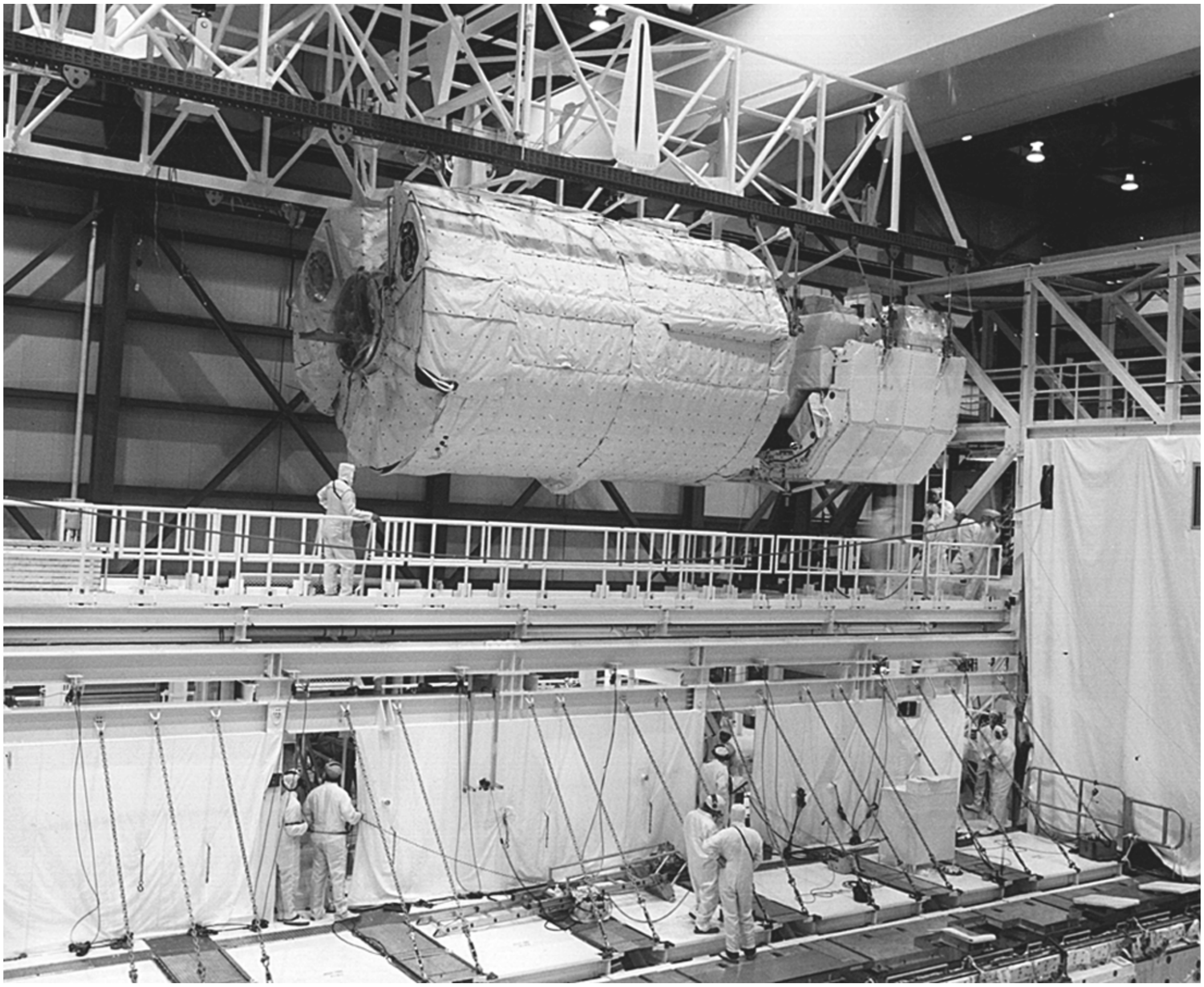


Figure 3-2.- Typical OPF horizontal installation/removal operations.

3.2 Orbiter Support Services

The Shuttle ground system and Orbiter vehicle will provide power and environmental control life support system (ECLSS) cooling to the payload as shown in Table 3-I.

The Shuttle ground system and Orbiter vehicle will provide data monitoring and communications as defined in Table 3-I and illustrated in Figure 3-3. Voice communications for payload personnel during test operations require drag-through cables from a ground operational intercommunication system (OIS). OIS connections are provided by the Shuttle at all test locations within the OPF and Launch Control Center (LCC).

Payload bay purge is provided on an around the clock basis with a few exceptions as documented in OMRSD. Payload bay purge is continuously provided with some exceptions (e.g., Orbiter transfer between OPF and VAB, Orbiter structural leak checks, OPF GSE periodic maintenance).

Access is unavailable to payloads when payload bay doors are closed. Access is available to the middeck on an as scheduled basis.

3.3 Orbiter Reconfiguration

Beginning at the UMPS milestone with the Orbiter horizontal in the OPF, flight-unique payload accommodation equipment is reconfigured to support the mission. This reconfiguration is a parallel activity with Orbiter scheduled maintenance. Tasks include, but are not limited, to:

- Installation of payload aft flight deck (AFD) crew station equipment (payload station and mission station)
- Reconfiguration of Space Shuttle mission kits (i.e., bridges, latch, standard mixed cargo harness (SMCH))
- Installation of payload-unique cabling and fluid lines in the AFD and payload bay
- Partial stowage of payload-unique equipment in the crew compartment
- Installation of mission extension accommodation kits, when applicable
- Installation and checkout of the remote manipulator system (RMS), when applicable
- Installation of the payload bay liner, when applicable

3.4 Orbiter Accommodations Interface Checkout

The Orbiter accommodations interface checkout is accomplished immediately after reconfiguration of the payload bay, middeck, payload stations, mission station, and general purpose computer (GPC) software reload. Each interface connection to the payload is tested for proper interfacing parameters per OMRSD, Mission Kits and Interfaces. Checkout is accomplished utilizing payload-unique mission equipment kits, Orbiter wiring, and control panels. The test includes, but is not limited to, payload interfaces listed in Table 3-II. Successful completion of this test verifies that Orbiter interface accommodations are ready to support horizontal payload installation.

3.5 Payload Bay Cleaning

Prior to payload installation and payload bay door closure in the OPF for flight, exposed and accessible payload bay surfaces will be inspected and cleaned as required to comply with standard level cleanliness requirements according to Contamination Control Requirements for the Space Shuttle Program, SN-C-0005. This cleaning process consists of inspection of all exposed and accessible payload bay surfaces from 5 to 10 feet with a minimum incident light level of 50 foot-candles, vacuuming and damp wipe of payload bay surfaces with lint free cloth as required to produce visibly clean surfaces. Payload bay liners will be provided on a case-by-case basis. Input air to the OPF will be nominally class 100, guaranteed class 5000 (HEPA) filtered) as specified in Clean Room and Work Station Requirements, Controlled Environment, Federal Standard 209, and will contain less than 15 ppm hydrocarbons based on methane equivalent. The customer is responsible for ensuring that payload elements are compatible with the induced contamination environment and comply with the outgassing requirements defined in ICD 2-19001.

When required for dedicated missions, sensitive and highly sensitive cleaning processes will be performed at this time. Special cleaning requirements will be identified in the IP, and special cleaning will be performed according to SSP standard requirements as defined in OMRSD.

3.6 Payload Installation

Installation activities in the OPF start with lifting the payload strongback from the payload strongback transporter and end with payload mechanical, fluids, and electrical systems connected to the Orbiter. Specific tasks include the following:

- Opening payload canister doors
- Attaching payload strongback to payload
- Hoisting payload from canister
- Mechanically installing payload into Orbiter
- Removal of strongback and canister
- Initiation of payload bay purge
- Connecting electrical, fluid, and gas interfaces
- Removal of trunnion endcaps (GSE), when used

Note: When payloads are designed to use only two longeron trunnions and one keel trunnion, a third longeron trunnion is required for payload installation. The additional longeron trunnion is necessary to provide both horizontal and vertical payload installation/removal capabilities. The third longeron trunnion may be provided as GSE at the customer's option. The trunnion must be designed to ensure that it can be safely installed and flown in place or safely installed/removed in the Orbiter work environment at the OPF or launch pad.

3.7 Interface Verification Test

The IVT is performed following completion of payload installation. It is the single test which verifies proper interface connections between the Orbiter and payload. This will be performed for each flow per requirements defined in OMRSD. This test will be accomplished using launch site integrated operations and maintenance instructions (OMIs), which verify Orbiter/payload interfaces. The necessary Orbiter and payload systems (such as power, ECLSS, instrumentation, data processing and software, displays and controls (D&C), and the GPC) will be activated to support the test. Selected data required from the Orbiter will be provided to the payload and selected data transmitted from the payload to the Orbiter will be verified. Orbiter/payload IVT includes the following:

- Activation of launch processing system (LPS) and firing room support equipment
- Pre-power switch list or switch scan
- Application of facility/GSE power
- Activation of facility/GSE fluid and gas support: Active thermal control coolant, hydraulics, pneumatics, and purges
- Activation and verification of Orbiter subsystems: Instrumentation, active thermal control, electrical power distribution and control, data processing and software, and communications and tracking
- Orbiter-to-payload interface activation and verification of all interfacing systems as follows: Copper path primary and secondary power and command and data circuits, radio frequency (RF) interfaces, fluid and gas services when applicable, pyro firing circuits, T-0 umbilical services, and Orbiter-payload retention hardware when applicable.

Table 3-I.- SPACE SHUTTLE SUPPORT SERVICES

LOCATION → / SERVICES ↓	UP MISSION PROCESSING							POSTLANDING				CANISTER		
	OPF	TRANSFER TO VAB	VAB LIFTING OPS	VAB-MLP	TRANSFER TO PAD	PAD-PCR	PAD-MLP	SLF	TOW	FERRY PREPS MDD	FERRY	TRANSFER	OPF	PAD
ORBITER														
DC POWER	X			X			X	X	X$^{(1)}$	X$^{(1)}$				
ECLSS COOLING	X			X			X	X	X$^{(1)}$	X$^{(1)}$				
PAYLOAD BAY PURGE	X			X	X		X	X	X	X				
TLM DATA	X			XX			X	X	X$^{(1)}$					
RF COMM	X						X	X	X$^{(1)}$					
LDB UPLINK	X			X			X							
CABIN ACCESS	X			X			X	X		X				
PAYLOAD BAY ACCESS	X						X			X				
T-0 UMBILICAL	X			X	X		X							
FACILITY														
POWER$^{(2)}$	X			X		X	X	X	X	X				
ENVIRONMENTAL CONTROL	X					X		X				X	X	X
DATA	X			X		X	X							
OIS/COMM	X			X		X	X	X	X	X				
LPS	X			X		X	X	X						
OTV, PAYLOAD VIEW	X					X								

(1) Limited capability depending on remaining mission consumables

(2) AC power only

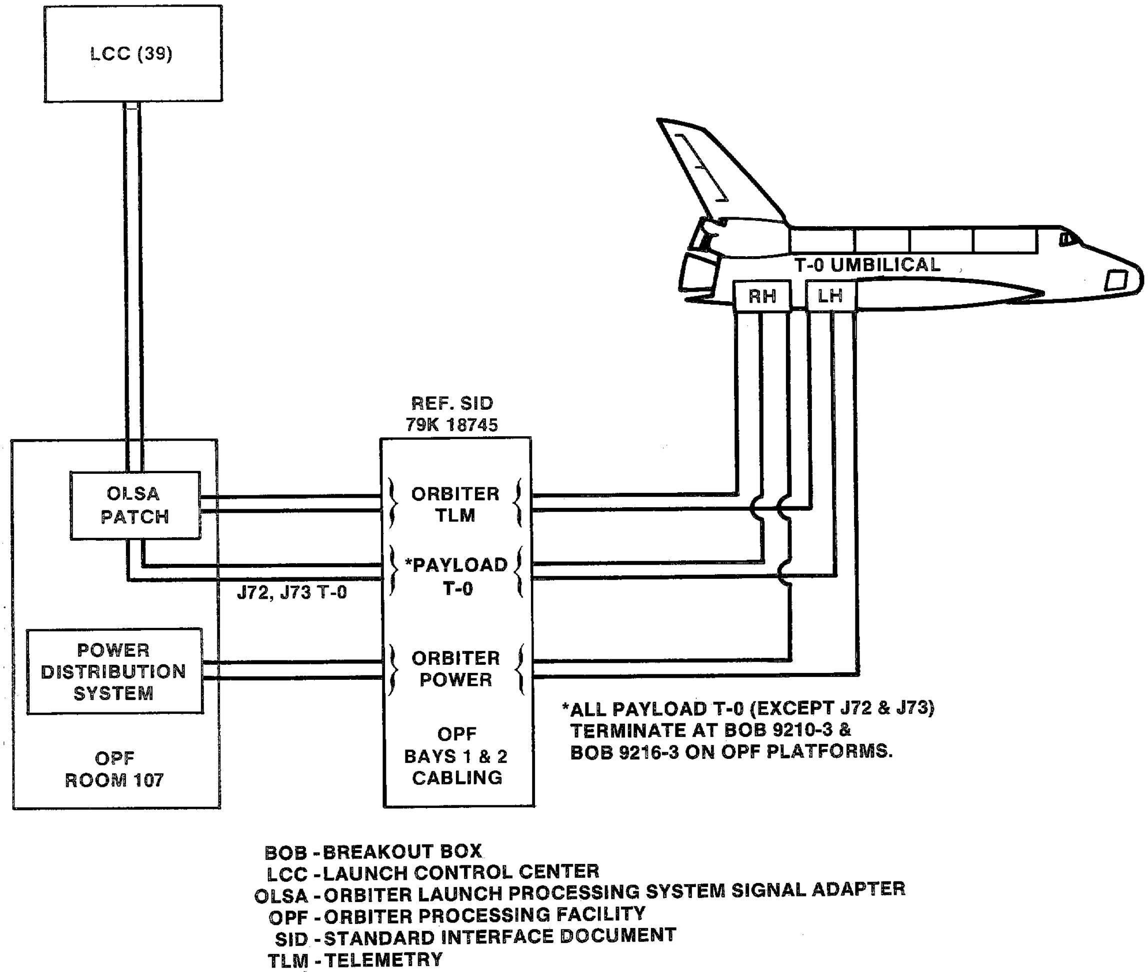


Figure 3-3.- OPF data and communications T-0 cabling interfaces.

Table 3-II.- ORBITER ELECTRICAL ACCOMMODATIONS

Payload Data Interleaver /Pulse Code Modulation Master Unit
Payload Interrogator/Payload Signal Processor
Orbiter Payload Recorder
Multiplexer/Demultiplexers
Payload Timing Buffer
Caution and Warning
General Purpose Computer/Multifunction Cathode Ray Tube Display System
S-band/Ku-band Signal Processor
Payload Deployment and Retrieval System
Leak Check of Fluid and Gas Systems
Standard Switch Panel
T-0 Umbilical

Some reverification of payload systems may be required as a result of payload installation into the Orbiter. When reverification is required, it must be completed prior to the completion of the IVT. Flight hardware shall be designed to minimize the use of one-g support devices, carry-on test equipment or drag-on cables. All drag-on equipment must be designed to meet ground operations safety requirements and be approved for use by the SSP.

End-to-end (ETE) test capabilities exist and will be defined in the OMRSD.

3.8 Payload Bay Closeout

This activity includes payload closeout, removal of access GSE, and payload bay door closure. If payload bay door closure is for flight, the following will be accomplished:

- Final payload inspection
- Payload GSE removal for flight
- Payload bay radiator inspection and cleaning as required in accessible areas
- Closeout photographs
- RMS stowage and extravehicular activity (EVA) slidewire pinning
- Payload bay sharp edge inspection
- Category B ordnance connection
- Payload bay door closure for flight

3.9 Post-payload Bay Closeout

After payload bay closeout, personnel access to the payload or the payload bay is not available in the OPF.

3.10 Preparations for Transfer

This activity includes cabin securing, removal of all access platforms from around the vehicle, and lowering the Orbiter onto the Orbiter transporter system (OTS).

3.11 Transfer from the Orbiter Processing Facility to the Vehicle Assembly Building

Transfer operations begin in the OPF with the disconnect of the Orbiter from the OPF including power, cooling, and payload bay purge. Once the Orbiter is disconnected, Orbiter weight and center-of-gravity (c.g.) determinations are performed. The Orbiter is then towed from the OPF into the VAB transfer aisle where lifting slings are attached. Then it is hoisted to the vertical position and mechanically mated to the Space Shuttle vehicle and the T-0 umbilicals are mated to the Mobile Launch Platform (MLP).

Orbiter power, cooling, and payload bay purge will be turned off in the OPF at the Orbiter disconnect milestone until the Orbiter element is mated to the T-0 umbilical on the MLP. The payload bay purge interrupt during Orbiter transfer to the VAB from the OPF will typically be 100 hours.

When authorized in the IP, T-0 umbilical power and a purge of up to 12 hours can be reinitiated while the Orbiter is on the OTS in the OPF prior to transfer to the VAB.

3.12 Vehicle Assembly Building Operations

Orbiter payload bay doors cannot be opened in the VAB, so there is no access to the payload or the payload bay. Access to the middeck and flight stations will be provided through the crew compartment hatch on a scheduled basis with shuttle ground operations.

3.13 Mobile Launch Platform Facility Services Available for Payloads

The MLP provides facility services for payloads via the T-0 umbilical panels as follows:

- Customer GSE located in MLP Room 10A may communicate with and supply DC power to payloads via the T-0 umbilical (for T-0 service specifics, refer to KSC-DL-116).
- Payload bay purge is provided continuously from T-0 umbilical mate on the MLP in the VAB until launch, except during transfer from GSE to facility services and during equipment test/changeover.

3.14 Space Shuttle Transfer to Pad Operations

This function starts with first motion of the crawler/transporter carrying the shuttle vehicle from the VAB and ends when the MLP is connected to the pad. Payload operations in the Payload Changeout Room (PCR) are terminated during movement of the transporter/MLP/Space Shuttle up the pad slope. Payload operations may be resumed after docking is complete. No Orbiter or MLP access is permitted during rollout from the VAB to the launch pad. Customer GSE located in MLP Room 10A may communicate with and supply dc power to the payload via the T-0 umbilical.

3.15 Pad Operations for Horizontally Installed Payloads

Following initial connection of the MLP to the launch pad interfaces, all Shuttle ground system and Orbiter internal systems providing services to payloads will be available around the clock, as scheduled. Payload operations on the pad will be minimized for horizontally installed payloads. Late access inside a habitable module for life sciences is available using the module vertical access kit (MVAK). Late access inside the MPLM for life sciences is available using the Payload Late Access Platform (PLAP)/Payload Late Access Kit (PLAK). Payloads must identify this requirement early in the planning process. There is no planned payload bay door opening at the pad. However, late access for unique servicing and adjustment of payload elements after hypergolic servicing operations is possible through the payload bay doors. Late access to the payload must end at L-60 hours, and it is recommended that access end at L-84 hours to allow time for payload bay door closure prior to the start of launch countdown. Late payload bay access which extends into the countdown is addressed in section 1.3. Unique access equipment to reach payload equipment from the PCR payload ground handling mechanism (PGHM) access platforms will be provided by the payload customer or by the SSP.

Access to the AFD and middeck stations is provided through the Orbiter crew compartment until the completion of flight crew equipment (FCE) critical stowage at L-14 hours.

Electrical power outlets are provided on the pad surface in the area of the rotating service structure (RSS) for payload GSE vans, transporters, and servicing equipment.

Space Shuttle ordnance connection and hypergolic servicing operations require that the pad be cleared of all payload personnel. Prior to personnel egress, all non-hazard-proofed GSE must be powered down.

Vertical Payload Flow Processing

4

4.1 Orbiter Reconfiguration

Beginning at the UMPS milestone with the Orbiter horizontal in the OPF, flight-unique payload accommodation equipment is reconfigured to support the mission. This reconfiguration is a parallel activity with the Orbiter scheduled maintenance. Tasks include but are not limited to:

- Installation of payload AFD crew station equipment (payload station and mission station)
- Reconfiguration of Space Shuttle mission kits (i.e., bridges, latch, SMCH)
- Installation of payload-unique cabling and fluid lines in the AFD and payload bay
- Partial stowage of payload-unique equipment in the crew compartment
- Installation of mission extension accommodation kits, when applicable
- Installation, checkout, or removal of the RMS when applicable
- Installation of the payload bay liner, when applicable

4.2 Orbiter Accommodations Interface Checkout

The Orbiter accommodations interface checkout is accomplished immediately after reconfiguration of the payload bay, middeck, payload station, mission station, and GPC software reload. Each interface connection to the payload is tested for proper interfacing parameters per OMRSD. It is accomplished utilizing payload-unique mission equipment kits, Orbiter wiring, and control panels. The test includes, but is not limited to, the payload interfaces listed in Table 3-II. Successful completion of this test verifies that Orbiter interface accommodations are ready to support Space Shuttle transfer to the pad and payload installation.

4.3 Payload Bay Cleaning

Prior to payload bay door closure for OPF rollout, exposed and accessible payload bay surfaces will be inspected and cleaned as required to comply with standard level cleanliness requirements according to SN-C-0005. This cleaning process consists of inspection of all exposed and accessible payload bay surfaces from 5 to 10 feet with a minimum incident light level of 50 foot-candles and vacuuming and damp wipe of payload bay surfaces. Payload bay liners will be provided on a case-by-case basis. Input air to the OPF and PCR will be nominally class 100, guaranteed class 5000 (HEPA filtered) as specified in Federal Standard 209 and will contain less than 15 ppm hydrocarbons based on methane equivalent. No further cleaning at the pad will be performed prior to payload installation. The customer is responsible for assuring that payload elements are compatible with the induced contamination environment and comply with the outgassing and induced contamination environment requirements as defined in ICD 2-19001.

Sensitive and highly sensitive cleaning processes will be performed at this time if required for dedicated missions. Special cleaning requirements will be identified and baselined in the IP. Cleaning will be performed according to SSP standard requirements as defined in OMRSD.

4.4 Payload Bay Closeout in the Orbiter Processing Facility

This activity includes payload closeout, removal of access GSE, and payload bay door closure. Items accomplished prior to payload bay door closure when a subsequent door opening is planned are:

- Payload GSE removal
- Payload bay radiator inspection and cleaning as required
- Closeout photographs
- RMS stowage and EVA slidewire pinning
- Payload bay sharp edge inspection
- Category B ordnance connection
- Payload bay door closure

4.5 Post-payload Bay Closeout

Personnel access to the payload bay is not available.

4.6 Preparations for Transfer

This activity includes cabin securing, removal of all access platforms from around the vehicle, and lowering the Orbiter onto the OTS.

4.7 Transfer from the Orbiter Processing Facility to the Vehicle Assembly Building

Transfer operations begin in the OPF with the disconnect of the Orbiter from the OPF facility including power, cooling and payload bay purge. Once the Orbiter is disconnected, Orbiter weight and center of gravity (c.g.) determinations are performed. It is then transported from the OPF into the VAB transfer aisle where lifting slings are attached. The Orbiter is hoisted to the vertical position and mechanically mated to the Space Shuttle vehicle; the T-0 umbilicals are then mated to the MLP.

Orbiter power, cooling and payload bay purge will be turned off in the OPF at the Orbiter disconnect milestone until the Orbiter element is mated to the T-0 umbilical on the MLP. The payload bay purge interrupt during Orbiter transfer to the VAB from the OPF typically lasts 100 hours.

4.8 Vehicle Assembly Building Operations

The payload bay doors cannot be opened in the VAB; therefore, access to the payload bay is not available. Access to the middeck and flight stations will be provided through the crew compartment hatch as scheduled with Shuttle Ground Operations.

4.9 Mobile Launch Platform Facility Services Available for Payloads

The MLP provides facility services for payloads via the T-0 umbilical panels as follows:

- Customer GSE located in MLP Room 10A may communicate with and supply DC power to payloads via the T-0 umbilical (for T-0 specifics refer to KSC-DL-116).
- Payload bay purge is provided continuously from T-0 umbilical mate on the MLP in the VAB until launch, except during transfer from GSE to facility services and during equipment test/changeover.

4.10 Space Shuttle Transfer to Pad Operations

This function starts with first motion of the crawler/transporter carrying the Shuttle vehicle from the VAB and ends when the MLP is connected to the pad. Payload operations in the PCR are terminated during movement of the transporter/MLP/Space Shuttle up the pad slope. Payload operations may be resumed after docking is complete. Orbiter access is not permitted during rollout from the VAB to the launch pad.

4.11 Payload Support and Operations at the Pad prior to Space Shuttle Arrival

Facility support services are provided from payload installation into the PCR until payload installation in the Orbiter and payload bay door closure, or payload removal from the PCR. RSS design and operations allow occupancy of the PCR for reconfiguration, checkout, and servicing operations immediately after pad safing operations following the previous launch. Launch Pad 39A Standard Interface Document, Kennedy Space Center, 79K18218, and Launch Pad 39B Standard Interface Document, Kennedy Space Center, 79K28802, provide current configurations of launch pad capabilities.

4.11.1 Payload Changeout Room/ Payload Ground Handling Mechanism Support Services

Payload support capabilities within the PCR include provisions to accommodate payload standalone test, servicing, systems checkout, installation and/or removal, and associated access.

4.11.1.1 Environmental and Contamination Control

PCR environmental parameters are:

- Temperature 71 ± 6 degrees F (21.7 ± 3.3 degrees C)
- Relative humidity 55 percent (maximum)
- Hydrocarbons (HC) = <15 ppm based on methane equivalent
- Nonvolatile residue (NVR) = 1.0 mg/0.1m^2/month (maximum)

A localized payload air conditioning (LPAC) system can be provided to the PCR from side 2. The supply is split in two branches, each having a dump valve outside the PCR. One branch has two spigots; spigot A on level 2 and B on level 4. The other branch has only one spigot; spigot C on level 4. KSC will provide 10-inch diameter flexible ducting from the facility spigot to an area adjacent to the payload. The customer will provide ducting from this area to the payload. Capabilities of the system include the following:

Supply:

- Temperature - Adjustable at the source between 55 degrees and 75 degrees F minimum/ maximum range including ±5 degrees at a given setting (12.8 to 23.8 degrees C ±2.8 degrees C). At lower supply flow rates a higher temperature can be delivered.
- Relative humidity - 30 to 55 percent, (adjustable)

Spigot:

- Flow - Adjustable between 0 and 250 lbs/min (0-113.4 kg/min). The three spigots and dump valves are balanced to achieve requirement at the specified total flow rate.
- Temperature and humidity is not controllable for individual spigots.

To minimize payload element contamination during PCR operations, a GSE debris shield is available. The shield may be installed where 24 inches exist between payloads and if no access is required through the volume between the payloads. The payload customer may request the shield when the above criteria allow installation prior to payload arrival at the pad.

4.11.1.2 Changeout

The PCR provides capability for on-pad changeout of trunnion-supported “like” payloads that do not affect Orbiter accommodations.

4.11.1.3 Handling

Installation or removal of integrated payload(s) to or from the payload bay is provided by the PGHM in the PCR. The PCR/PGHM is capable of handling up to four individual payloads weighing up to 65,000 pounds (29,483.5 kg) total.

When payloads are designed to use only two longeron trunnions and one keel trunnion, a third longeron trunnion is required for payload installation. The additional longeron trunnion is necessary to provide both horizontal and vertical installation and removal capabilities. The third longeron trunnion may be provided as GSE at the customer's option. The trunnion must be designed to ensure that it can be safely installed and flown in place or safely installed and removed in the Orbiter work environment at the pad or OPF.

The PGHM is a structural steel assembly suspended by an overhead bridge that rolls on rails mounted in the top of the PCR. This PGHM is capable of handling and installing payloads and/or payload segments up to 15 feet in diameter, 60 feet in length and weighing up to 65,000 pounds (29,483.5 kg). The J-hook fittings are capable of being pinned onto the payload support beams of the strongback portion of the PGHM at the same X_o locations as the trunnion fittings on the payloads. The PGHM has hydraulically adjusted J-hooks) at each of the payload longeron trunnions. All payloads must have trunnions located at Z_o 414 inches and $Y_o \pm 90.125$ inches to be compatible with the PGHM, as defined in ICD 2-19001. For payloads of a smaller diameter than 15 feet, a payload support will be required with trunnions at the previously mentioned locations. Minimum allowable longeron trunnion spacing for vertical installation/removal of the payloads is 27.53 inches. The adjustment of each individual J-hook is plus 2 minus 1 inch in X_o axis, ±1.5 inches in Z_o axis and ±0.5 inch in Y_o axis for primary J-hooks and ±1.5 inches in Z_o axis for secondary J-hooks. The strongback is adjustable in the "ganged" mode (payload support beams and primary J-hooks) 15 inches in the X_o axis and ±4 inches in the Y_o axis. Unlimited adjustment in the Z_o axis is provided by the capability of the PGHM to roll the full length of the rails in the top of the PCR.

During PGHM operations with a payload consisting of two segments, a closing or an opening displacement between the segments can occur. Any cross connections between segments, i.e., cables, fluid lines, etc., must be designed to account for the expected displacements as defined in ICD 2-19001.

The payload component handling equipment hoist system can lift payload components and associated handling equipment from payload elements installed on the PGHM and translate them to fixed work platforms. Maximum single item weight is 400 pounds (181.4 kg). Devices for lifting GSE and payload elements up to 8,000 pounds (3628.7 kg) to and from various platform levels are provided in the PCR.

4.11.1.4 Access in the Payload Changeout Room

With the payload installed in the PCR and the PGHM in the retracted position, the PCR provides five fixed platforms in addition to the base floor for payload support operations. Each platform provides space of approximately 600 square feet which is allocated for payload-related equipment use and is designed for 100 lb/ft^2 (488.2 kg/m^2) capability. Point loading in excess of 100 lb/ft^2 must be approved by launch site personnel.

Utilizing the platforms specified above and the extensible platforms, capability is provided at LC-39A for 360-degree access around the longitudinal axis of a 60-foot cylindrical payload from 5 to 15 feet in diameter with a plank width of 1 foot. Extensible platforms are designed for loading capability of up to 50 lb/ft^2 (244.1 kg/m^2). LC-39B provides 360-degree access for payloads 5 to 13 feet in diameter with a plank width of 2 feet.

With the payload installed in the Orbiter payload bay and the PGHM in the forward position, the following payload personnel and equipment access is provided:

- With the payload bay doors open and the PGHM extended to the Orbiter mold line, access is provided by five fixed PGHM levels
- Most Orbiter/payload accommodation interfaces are accessible by the PGHM extensible platforms, which have a live load capability of 50 lbs/ft^2 (244.1 kg/m^2)
- Any unique payload access GSE from the PGHM platforms to payload equipment will be provided by the customer or by the SSP
- The Orbiter midbody umbilical is accessible by platforms external to the PCR when the RSS is extended around the Orbiter

The PLAP and PLAK are installed on the PGHM. The PLAP is a platform that is attached to the PGHM and extends into the Orbiter payload bay allowing access to the MPLM. The PLAK is installed on the PLAP providing access to the MPLM hatch and internal module areas. The PLAK is a late access kit consisting of two cargo hoists and a telescopic boom with extendible flip platforms. The PLAK platforms provide a working floor inside the module while the module is in the vertical position.

4.11.1.5 Payload Changeout Room Ingress/Egress

An airlock on the 130-foot level provides ingress/egress of payload operating personnel, payload-related GSE, and payload elements. The airlock is sized to accommodate equipment not to exceed a maximum envelope of 6 feet in height x 8 feet in width x 8 feet in length (1.8 m x 2.4 m x 2.4 m), a total weight not to exceed 8,000 pounds (3628.8 kg) and a point loading of 100 lbs/ft^2 (488.2 kg/m^2). Personnel access is normally provided through an anteroom with an airlock to accommodate a security monitor station, clean garment donning area, clothing storage, shoe cleaning equipment, and a personnel air shower. Emergency egress capability is provided from each PCR primary work level to a location external to the PCR.

4.11.1.6 Communications and Data at the Pad

Facilities for communications are provided from the PCR via the T-0 umbilical (for T-0 service specifics, refer to KSC-DL-116) after its installation into the Orbiter. Customers may utilize this capability as follows:

- Customer voice communication capability is provided by the NASA Operational Intercommunication system digital (OISD) within KSC and may be patched to specific locations within Cape Canaveral Air Force Station (CCAFS). Payload data lines are provided from the launch PTCR to specific locations within KSC and to CCAFS remote site interfaces. Payload GSE may be utilized from the PTCR, PCR and/or MLP Room 10A to these locations.

Both wideband (30 Hz to 4.5 MHz) and digital (RS-422 and RS-423 up to 256 kbps data rate (NRz)) transmission systems are available for telecommunications to and from the launch pads.

- An open loop RF communication capability is provided for payload(s) to communicate from LC-39A and LC-39B to the payload facilities using S-band frequencies.

Data relay and repeater antennas for all four frequency bands are located on the Fixed Service Structure (FSS) 275-foot level and connected via coaxial cables and waveguides to patch panels in the FSS, PTCR, RSS, PCR, and MLP Room 10A (S-band only). Pickup antennas or hat couplers as required will be provided by the customer. Cable trays, waveguide supports, penetration plates, and personnel access platforms are provided by the facility for installation of equipment.

Payload Antenna Repeater System User's Planning Guide, KSC-HB-0004.0 contains additional details.

- Telephones are provided at all internal PCR levels and at specified critical locations to provide onsite and offsite communications. Each telephone handset has a press-to-talk capability or a confidence device.
- IRIG-B timing signals are provided at all interior PCR platform levels and at the pad surface park site for payload GSE vans.

4.11.1.7 Electrical Power

Commercial quality electrical power is provided on both sides of all interior PCR platform levels for 120/208 Vac, 3 phase (60 Hz at 36 kVA each) and 120 Vac, single phase (60 Hz at 4.8 kVA each).

Single-point emergency manual cutoffs, (one each for ac and dc) are provided at each major work level. Connected GSE heat loads shall not exceed 100,000 Btu/hr (105,435 kJ/hr).

Electrical power outlets are provided on the pad surface in the area of the RSS for payload GSE vans, transporters and servicing equipment.

4.11.1.8 Consumables Servicing

Capability for supporting payload consumables loading, unloading, pressurization venting, and draining is provided. Payload consumables handling is accomplished by payload furnished GSE.

4.11.1.9 Payload Changeout Room Cleaning System

A built-in vacuum system for cleaning payload elements and support equipment is provided with inlets in the airlock, anteroom, and both sides of each interior PCR work platform level.

4.11.1.10 Radio Frequency Shielding

The PCR provides limited attenuation to RF radiation. Specific analysis can be performed for payload-specific concerns.

4.11.1.11 Pneumatics

GN_2 and GHe manifolds are provided to all work platform levels on the RSS pivot point side of the PCR. Outlets shall be capable of providing 3000 $\pm$100 psig (210.9 $\pm$ 7 kg/cm^2) per the specification in <u>Space Shuttle Fluid Procurement and Use Control</u>, SE-S-0073.

A stainless steel special purity gas supply line is provided from the launch pad to an outlet on PCR level 4. The customer will provide gas supply and controls at the outlet.

4.11.1.12 Utility Air

A compressed filtered air source within the PCR (up to 120 psig (8.4 kg/cm^2)) is provided with outlets appropriately positioned on the major work platform levels. A compressed air source (up to 120 psig (8.4 kg/cm^2)) is also provided at the pad surface for the payload canister when the RSS is retracted. Equipment using the utility air must be connected to the pneumatic tool air vent system.

4.11.1.13 Support Trailers

Trailers may be used on the pad for testing and support but must be removed prior to flight readiness firings, launch, and at other times as required by launch operations. An area adjacent to the RSS hinge column provides parking for up to three 10-foot x 50-foot (3 m x 15.2 m) trailers containing payload GSE, and parking for a gas trailer approximately 8 feet x 40 feet (2.4 m x 12.2 m).

4.11.2 Payload Transfer/Canister to Payload Ground Handling Mechanism/Payload Changeout Room

Payload installation in the PCR is performed with the RSS in the retracted position and includes, but is not limited to, the following:

- Payload transporter and canister positioning on the pad surface
- Clearing the pad to the perimeter fence of all nonessential personnel if payload has hazardous components or propellants
- Hoisting and mating of the payload canister to the RSS
- Purging the canister - PCR interstitial area
- PGHM extraction of the payload from the canister
- Translation of the PGHM/payload to the aft position of the PCR
- Closing PCR/canister doors
- Extending PCR access platforms
- Removal of the payload canister from the RSS and launch pad

After the payload/PGHM is in the aft PCR position an inspection of the PCR/payload will be performed by Shuttle personnel and the payload customer to verify compliance with payload cleanliness requirements. When the inspection and/or cleaning is complete the payload customer may begin standalone operations.

Typically the SSP provides a two-day planned window for the total payload complement of scheduled standalone operations. If operations are not completed prior to Space Shuttle/MLP/ transporter arrival, operations must be terminated and the PCR evacuated until the Space Shuttle/MLP/transporter proceeds up the pad ramp and hard docking of the MLP to the pad is accomplished.

4.12 Integrated Space Shuttle Payload Operations

Installation of the payload into the RSS/PCR occurs before or after Shuttle transfer to the launch pad. Once the Space Shuttle vehicle is positioned on the pad, the RSS is moved into position to enclose the Orbiter payload bay, and environmental seals are established. The space between the closed Orbiter and RSS/PCR doors (interstitial area) is purged with clean air, and the PCR and payload bay doors are opened.

4.12.1 Payload Installation - Orbiter

This function includes, but is not limited to, the following:

- Extension of PGHM into the payload bay
- Mechanical connection of Orbiter/payload interface
- Electrical preconnect checks followed by connection of Orbiter/payload interface
- Fluid connection of Orbiter/payload interface
- Removal of trunnion endcaps (GSE), when used
- Repositioning and connection of GSE, as required
- Sharp edge inspection of payloads

4.12.2 Interface Verification Test

The IVT is performed following completion of payload installation. It is the single test which verifies proper interface connections between the Orbiter and payload. This test is performed for each flow according to requirements defined in OMRSD. The IVT is accomplished using launch site integrated OMIs, which verify Orbiter/payload interfaces. The necessary Orbiter and payload systems (such as power, ECLSS, instrumentation, data processing and software, D&Cs, and GPC) will be activated to support the test. Selected data required from the Orbiter will be provided to the payload and selected data transmitted from the payload to the Orbiter will be verified. Orbiter IVT includes:

- Activation of LPS and firing room support equipment
- Pre-power switch list or switch scan
- Activation of facility/GSE power
- Activation of facility/GSE fluid and gas support, including active thermal control coolant, hydraulics, pneumatics and purges
- Activation and verification of Orbiter subsystems including instrumentation, active thermal control, electrical power distribution and control, data processing and software, and communications and tracking
- Verification of interfacing systems, including copper path primary and secondary power, command and data circuits, RF interfaces, fluid and gas services when applicable, pyrotechnic firing circuits, T-0 services, and Orbiter-payload retention hardware when applicable.

Some payload systems reverification may be required as a result of payload installation into the Orbiter. When reverification is required, it must be completed prior to the completion of the IVT. Flight hardware shall minimize use of one-g support devices, carry-on test equipment or drag-on cables. All drag-on equipment must be designed to meet ground operations safety requirements and approved for use by the SSP.

A payload ETE test is available.

4.12.3 Payload Ordnance/Servicing

Final payload and Orbiter payload bay ordnance connections will be accomplished as late as possible, but prior to payload bay door closure for Space Shuttle hypergolic servicing for payloads that do not require later access. For payloads that require access for servicing after Space Shuttle hypergolic loading, ordnance will be connected as late as possible during the pad processing prior to final payload bay door closure. Humidity levels near the payload ordnance should be above the 30 to 55 percent RH.

Access required for late payload servicing will be provided. Payload servicing may include, but is not limited to, the following:

- Topping-off expendable commodities
- Battery charging or installation
- Special nuclear material installation
- Limited-life hardware or scientific samples

4.12.4 Payload Closeout and Final Orbiter Payload Bay Door Closure

Regardless of whether final payload bay door closure occurs prior to hypergolic servicing, after hypergolic servicing but before countdown operations, or during countdown operations, the following activities will occur:

- Final payload bay and payload sharp edge inspection by astronauts
- Payload bay /radiator inspection and cleaning in accessible areas as required
- Orbiter/payload GSE removal for flight
- Final payload/Orbiter payload bay inspection
- Close out photographs
- Stowing RMS and pinning EVA slide wire
- Pyrotechnic safe and arm pin removal
- Removal of payload-unique ground support platforms from payload bay and PGHM
- Retraction of PGHM from payload bay
- Payload bay door closure for flight
- Removal of payload bay door strongbacks

Combined Flow Processing

5

The combined flow processing (Figure 5-1 and 12-1) accommodates a group of payloads installed horizontally and then a second set of payloads installed vertically. The combined flow process is not a payload customer option. Instead, the flow is determined by the SSP as a manifest option when it is considered advantageous for manifest purposes.

Combined processing provides the same support services to the horizontally installed payloads as described in Section 3 and vertical support as described in Section 4. Refer to Sections 3 and 4 for detailed flow processing requirements and information.

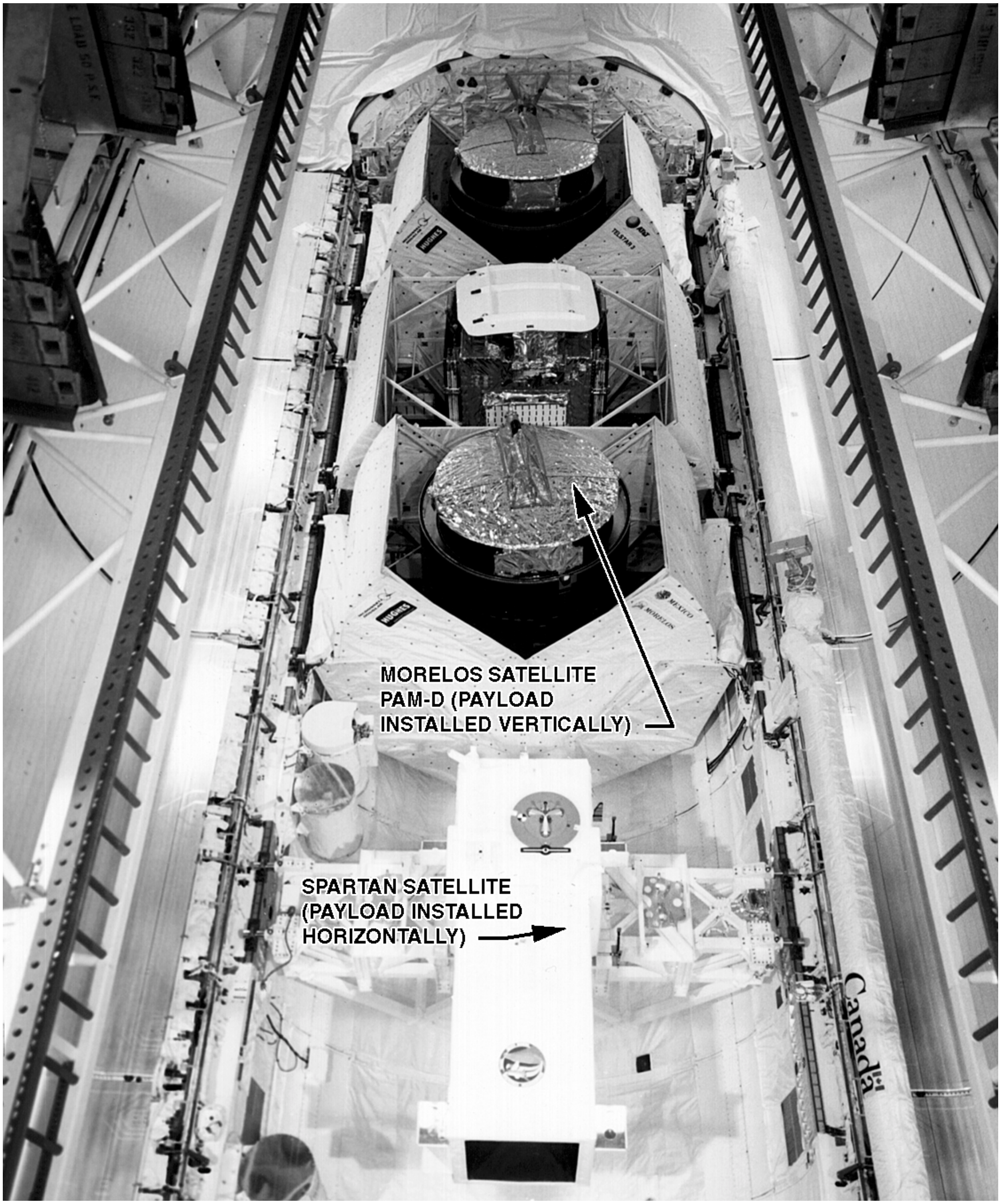


Figure 5-1.- Typical combined flow payload bay closeout.

Launch Countdown Operations

6

6.1 General

Shuttle launch countdown operations are activities required to close out, activate, service, and sequence Shuttle and payload systems until SRB ignition. The precount hours immediately before picking up the launch countdown clocks are normally used to perform most closeout activities such as Orbiter aft compartment, payload bay (including payload servicing), and nonswing arm pad access areas. Countdown clock activities depend on the mission. Typically, clocks start at L-76 hours. Two countdown clocks are active. The "L" clock indicates the actual time remaining until liftoff. The "T" clock indicates a countdown time with predefined clock hold points which allow time for work catchup, troubleshooting, and ground crew shift changes that do not affect critical activities.

6.2 Launch Readiness

Payload readiness for launch will be confirmed prior to payload bay door closure, when the payload is in launch configuration and capable of sustaining this configuration, as defined in sections 2.2 and 2.3, without physical access. Payloads that require power-on after payload bay door closure must assure that all safety requirements for command and monitoring are met for the prelaunch configuration. Prelaunch control and monitoring of payload functions will be provided at a payload GSE control room located onsite, a Payload Operations Control Center (POCC), or the SSP Launch Control Center. Commanding is nominally completed no later than the start of Space Shuttle cryogenic propellant loading at 11 hours before launch. If commands are required between L-11 hours and T-9 minutes they must be approved by the SSP and documented in NSTS 16007, Shuttle Launch Commit Criteria and Background, Appendix C. If the commands are mandatory for launch, redundancy in communications links, ground command systems, and telemetry verification capability is required. Payload commanding will not be permitted after the start of the T-9 minute hold, which is normally a 10-minute duration.

6.3 Launch Commit Criteria

Payload LCC will be developed by all customers in accordance with the following requirements and constraints. Any LCC that exceed ground rules or constraints specified herein will be negotiated with the SSP as exceptions.

Documentation Requirements:

NSTS 16007

- All payload parameters utilized for safety monitoring during the count and criteria used for calling safety related holds
- Specific actions and payload commanding initiated by the customer after pad clearing which, if unsuccessful, could cause a launch hold
- Orbiter payload interface services (i.e., payload data interleaver (PDI), power, etc.)

Flight Rules

Ground operations support decisions (i.e., POCC, communications lines, aircraft, etc.) which represent GO/NO-GO decisions

It is the customer's responsibility to document and maintain all criteria and payload parameter monitoring required at the customer's POCC/facility in addition to those defined in NSTS 16007 and the Flight Rules.

Groundrules /Constraints

- Payload safety holds may be called until L-31 seconds as negotiated in the launch commit criteria of the IP. Exceptions to this rule will be negotiated with the SSP and documented in the IP and NSTS 16007. NSTS 16007 will identify parameter limits and loss of inhibits used as a basis for the safety hold.

- All mission success and safety launch commit criteria must be monitored via ground display and must not rely on flightcrew monitoring.

- All customer-initiated holds will be verbal. No payload parameters will be permitted in the ground launch system.

- The customer is required to immediately notify the SSP whenever a payload launch concern arises.

- Mission success related launch holds may be called only by primary payloads

- Any function whose failure results in a mission success hold must be monitored such that no single failure will result in a loss of visibility into the status of that function. Any exception to this requirement must be negotiated and identified in the IP.

- For a confirmed loss of a total function which would cause the loss of primary mission objectives, the customer may call a hold until L-31 seconds of the countdown.

- For payloads with mission times consistent with Shuttle flight length, the customer may call a hold up until T-9 minutes of the countdown for a confirmed loss of redundancy of a flight function which would affect primary mission objectives. If a specific redundant system failure would jeopardize a majority of primary mission objectives, an exception may be considered by the SSP for holds until L-31 seconds. Any exception will be negotiated in the IP and documented in the customer's internal launch commit criteria documentation.

- For payloads with long term (multi-year) primary mission objectives that are at risk due to a confirmed loss of redundancy of a flight function when this redundancy is critical to mission lifetime, the customer may call a hold in the countdown until L-31 seconds. The fact that a payload will have launch commit criteria calls until 31 seconds will be negotiated in the IP, and the specific requirements will be documented in the customer's internal launch commit criteria documentation.

6.4 Middeck Payload Turnovers

Payload experiments may be installed during launch countdown. Reference Section 2.4

6.5 Late Stow for Habitable Modules

The Spacehab and MPLM may have stowage requirements during launch countdown. These will be defined per the OMSRD. Support hardware for access must be identified early in the flow. The MVAK is used to support Spacehab missions. It is a hoist system that supports both personnel and equipment through the crew cabin hatch. The PLAP/PLAK system is used in the payload bay prior to final door closure to stow items into the MPLM. It is a platform/ladder system with equipment hoist capabilities. Reference Section 4.11.1.4.

Postflight Operations for All Landing Sites

7

7.1 General

Postflight operations include activities accomplished from the time the Orbiter performs a nominal end of mission (EOM) or an intact abort landing), until it is returned to an OPF. These operations include runway support of crew, Orbiter, and payloads; Orbiter safing, deservicing, and preparation for ferry to KSC; payload support/removal when required; Orbiter ferry to KSC; and postmission payload activities.

7.2 Landing Site Activities

The runway portion of landing site activities begins when the Orbiter rolls to a stop after landing, continues through T-0 coolant and purge connections (Figure 7-1), and ends when the Orbiter is ready to be towed to the safing/deservicing facility. These facilities include the OPF at KSC, mate/demate device (MDD) at Edwards Air Force Base (EAFB), mate/demate area at White Sands Space Harbor (WSSH), and secure processing area at other landing sites.

Figure 7-1.- Orbiter landing operations, safety sniff check prior to connection of the T-0 umbilical.

7.3 Landing Site Support

Landing site support will vary depending on landing site selected (i.e., KSC or EAFB, etc.). Generally, convoy support to satisfy IP and OMRSD requirements will be available at KSC and EAFB. A full convoy is provided at the KSC only. Payload requirements for other landing sites and special postlanding services shall be negotiated with the SSP and documented in the IP. Support at KSC will include, but is not limited to, the following:

- Aided flight crew egress and ground crew ingress capability
- Required early access to middeck payloads and Orbiter experiments to preclude damage to hardware, time-critical samples**,** or loss of significant mission success data will be provided before start of tow.
- Under nominal conditions and RTLS, payload purge and ECLSS coolant will be applied to the Orbiter within 1 hour after landing at KSC. Payload bay purge will be applied at EAFB within 8 hours after landing. For EAFB landings, a payload bay purge can be applied as early as 90 minutes after landing as a standard service to meet identified payload requirements. Payload bay purge will be applied at transatlantic abort landing (TAL) or emergency landing sites within 72 hours after landing. Payload bay purge shall not be used to satisfy the technical requirements in NSTS 1700.7B.
- Orbiter vehicle power will be available as a minimum until flight crew egress

7.4 Payload Bay Early Access

The Orbiter vehicle provides physical access to the payload bay through the crew compartment and airlock hatches to satisfy habitable modules and similar payloads early access requirements. For safety reasons, other payload access will not be allowed until after power reactant storage distribution (PRSD) deservicing at approximately landing plus 4 days. These access requirements must be identified in the IP. Payload bay physical access requirements for a given mission must also be further defined in both IP and OMRSD unique to that mission. Any special provisions required (e.g., special access platforms) will be supplied by the payload customer. If no airlock destowage is required, airlock hatches can be opened to provide payload bay access at the following sites and estimated times:

RTLS - KSC	3.5 hours
Abort once around (AOA) - KSC, EAFB	3.5 hours
AOA - WSSH	2 days
Primary EOM - KSC, EAFB	3.5 hours
Alternate EOM - KSC	3.5 hours
TAL	6 days
Abort from orbit (AFO) to an emergency landing site	6 days

Actual removal times will be determined by mission-peculiar requirements and abort conditions. All unique SSP support required and serial impact times associated with early access will be negotiated and agreed to in the IP.

7.5 Postlanding Operations

When landing site runway operations are completed, the Orbiter is towed to a safing and deservicing facility or area. If the landing site is KSC, the Orbiter will be towed to the OPF for safing and deservicing. Remaining payloads and Orbiter experiments will be removed in the OPF, normally beginning at landing plus 19 hours. At landing sites other than KSC, safing and deservicing will be performed at a designated secure area. Following Orbiter jacking and leveling, any remaining middeck experiments and flightcrew equipment are removed. Orbiter ferry preparations are then accomplished and the Orbiter is mated to the Shuttle carrier aircraft (SCA) for ferry to KSC.

Payloads and/or airborne support equipment (ASE) aboard the Orbiter will remain there for the ferry flight back to KSC, if within the capability of the SCA. However, due to landing site location, weight, c.g., safety considerations, or mission-unique requirements, payloads may be removed from the payload bay horizontally and placed in customer-provided shipping containers and transported by the SSP to the launch site for return to the customer. Payload bay door opening times for start of payload removal operations are site-dependent. The following is a list of sites and estimated payload bay door opening times:

KSC	5 days
EAFB	7 days
WSSH	32 days
TAL	35 days
Emergency landing sites	39 days

Payload support and equipment required for payload removal at a location other than KSC shall be specified in the flight-specific annex to Offsite Operations Plan, KVT-PL-0014. This plan is prepared by KSC personnel utilizing customer-provided input.

Early access to the MPLM (R+5 to R+7 days) at KSC will be achieved after payload bay door opening and the Removable End Access Platform (REAP) is installed in the Orbiter payload bay.

All unique SSP support required and serial impact times associated with early access will be negotiated and agreed to in the IP.

7.6 Ferry Operations

Once the Orbiter to SCA mate is completed, the Orbiter is ferried to KSC. During the ferry flight, the SCA will maintain an altitude and flight duration to ensure a minimum payload bay temperature of 35 degrees F and minimum pressure of 8.0 psia. At designated overnight stops, a payload bay purge may be applied when specified in OMRSD and IP. After arrival at KSC, the Orbiter is removed from the SCA at the MDD and towed to the OPF.

The following are estimated times from landing at specific sites until the Orbiter is returned to the OPF (assuming no payload bay removal operations):

Primary EOM - EAFB	8 days
AOA - EAFB	8 days
AOA - WSSH	19 days
TAL	44 days
Emergency landing site	48 days

7.7 Payload/Airborne Support Equipment Download Operations

When the Orbiter arrives at the OPF, it is jacked and leveled. Any remaining middeck experiments are removed, and preparations for payload bay door opening are started. For missions that end at KSC, safing and deservicing of the Orbiter will be accomplished in the OPF prior to payload bay door opening. After the doors are opened, the payload and/or ASE are removed and transported to the appropriate facility for deintegration. Once the payload and/or ASE have been removed, the Orbiter is deconfigured and UMPS for the next mission begins.

Ground Operations Environments and Cleanliness Controls

8

8.1 Flight Hardware Cleanliness Level Definitions

- Standard - Absence of all particulate and nonparticulate visible to the normal unaided eye at a minimum light level of 50 foot-candles at a distance of 5 to 10 feet
- Sensitive - Absence of all particulate and nonparticulate visible to the normal unaided eye at a minimum light level of 50 foot-candles at a distance of 2 to 4 feet
- Highly sensitive - Absence of all particulate and nonparticulate visible to the normal unaided eye at a minimum light level of 100 foot-candles at a distance of 6 to 18 inches

8.2 Payload Bay Cleaning Prior to Payload Installation

Prior to payload installation, internal surfaces of the payload bay are inspected and cleaned, if required, to comply with a visibly clean level as defined in SN-C-0005. This inspection and cleaning will be accomplished within a CWA in order to isolate sources of contamination from critical regions. This CWA shall be continuously purged with nominally class 100, guaranteed class 5000 (HEPA filtered) air per Federal Standard 209, and will contain less than 15 ppm hydrocarbons, based on methane equivalent. The air within the CWA shall be maintained at 71 ± 6 degrees F (21.67 ± 3.3 degrees C) and 55 percent maximum humidity. The payload installation will be accomplished so as to avoid contaminating the payload or payload bay.

8.3 Contamination Control After Payload Installation

Subsequent to payload installation, accumulation of visible particulate and film contamination on all surfaces within the payload bay will be prevented by controlled work discipline, cleanliness inspections, and effective cleaning as required. The payload bay purge will continue with air which meets class, temperature, and humidity mission-unique requirements.

8.4 Preparation for Payload Bay Closeout

Prior to final closure of the payload bay doors, inspection and cleaning, as required, will be conducted to verify that all accessible surfaces within the payload bay, including predetermined external surfaces of payloads, meet the visibly clean level stipulated.

8.5 Closed Payload Bay Purge

The Orbiter is designed for closed payload bay purging after payload bay door closure using conditioned purge gas (air or GN_2) which meets the contamination/cleanliness criteria specified in ICD 2-19001.

The payload bay purge system is shown schematically in ICD 2-19001. Purge gas enters the Orbiter via the T-0 umbilical, and is ducted through the aft and mid fuselage, entering the payload bay via the purge manifold located on the forward bulkhead X_o 576. Purge gas exits the payload bay via check valves on the X_o 1307 bulkhead. Three mission kit spigots are provided to supply additional conditioned purge gas to meet mission-unique thermal conditioning requirements.

Purge gas from spigots to the required areas on/in the payload is distributed by a customer-supplied ducting mission kit attached to one, all, or any combination of the three spigots. The payload bay purge system supplies conditioned air to the payload bay during ground turnaround operations until conditioned GN_2 switchover prior to Orbiter cryogenics loading. The purge supplied to the payload bay has a temperature range from 45 to 100 degrees F (7.2 to 37.8 degrees C) , a flow range from 140 to 300 pounds per minute, and humidity less than 37 grains of water per pound of dry air (gR H_2O/lb).

8.6 Space Shuttle Online Payload Facilities

During payload processing and Orbiter operations at KSC, payloads and the payload bay are environmentally protected within the OPF and the PCR. Environmental and contamination control are provided in these facilities as defined in Shuttle Facility/Orbiter Contamination Control Plan, KVT-PL-0025.

The OPF high bays are good housekeeping areas (GHA) with localized class 100,000 CWAs located around the Orbiter payload bay. The CWAs are isolated by curtains from the surrounding area. The supply input air is nominal class 100, guaranteed class 5000, HEPA filtered and flows vertically in the payload processing area. The HVAC system supporting the Orbiter payload area maintains a slightly positive pressure within the entire high bay. Environmental parameters that are measured include temperature, relative humidity, airborne particulate, particle fallout, NVR, and hydrocarbons.

The PCR maintains a maximum airborne particulate level equivalent to class 100,000 per Federal Standard 209 during normal operations. The supply air is nominal class 100, guaranteed class 5000, HEPA filtered and flows through the PCR from top to bottom. The HVAC system supporting the PCR also supplies HEPA filtered air to the payload bay, personnel lockers and changeout room, equipment airlock, and support equipment storage room. Environmental parameters that are measured include temperature, relative humidity, airborne particulate, particle fallout, NVR, hydrocarbons, and positive pressure.

Related Ground Equipment and Space Shuttle Operations Support

9

9.1 Payload Canister

Payload canisters are provided at KSC to transport and install payloads (horizontally and vertically) weighing up to 65,000 pounds (29,483.8 kg). A canister will accommodate a payload with a maximum diameter of 15 feet (4.67 m) and a maximum length of 60 feet (18.29 m) (Figures 9-1 and 9-2).

Payload environmental requirements include the following:

- Temperature - 71 ± 6 degrees F (21.7 ± 3.8 degrees C)
- Relative humidity - 55 percent maximum

The payload canister shall provide a standard cleanliness level as defined by SN-C-0005, Table II. The payload canister interior shall be continuously supplied with class 100, guaranteed class 5000 (HEPA filtered) conditioned air, containing less than 15 ppm hydrocarbons.

When required for dedicated missions, sensitive and highly sensitive cleaning processes will be performed at this time. Special cleaning requirements will be identified in the IP and special cleaning will be performed according to SSP standard requirements as defined in OMRSD.

The sum of static and dynamic loadings sustained by the payload during handling and transportation shall be controlled per Launch Site Accommodations Handbook for Payloads, K-STSM-14.1.

Payload customers with payloads requiring special purges of payload elements should note that a mount for K-bottle and provisions for a bulkhead fitting are provided on the canister; bottle regulator and flexible lines are provided by the customer.

Payload electrical power capability during transportation is 115/120 Vac, single phase, 60 Hz at 1.8 kVA.

The canister provides 15 dB of RF attenuation in the frequency range from 10 MHz to 18 GHz.

9.2 Payload Environmental Transportation System

Use of the payload environmental transportation system (PETS) is restricted to onsite KSC (e.g., between the Payload Processing Facility (PPF) and the Vertical Processing Facility (VPF)) and the immediate KSC area. Any other use requires specific authorization and long-range scheduling with the payloads directorate at KSC.

The PETS is available to transport payloads weighing up to 24,000 pounds (10886.4 kg). PETS will accommodate a payload with a maximum diameter of 12 feet 6 inches (3.8 m) and a maximum length of 20 feet 6 inches (6.2 m) (Figure 9-3). Details are contained in Standard Interface Drawing PETS Multiuse Container, 82K00463.

a. The PETS internal environment capabilities are as follows:
   - Temperature - 70 ± 20 degrees F (21.1 ± 11.1 degrees C)
   - Relative humidity (RH) - 55 percent maximum
   - Cleanliness - 100 K

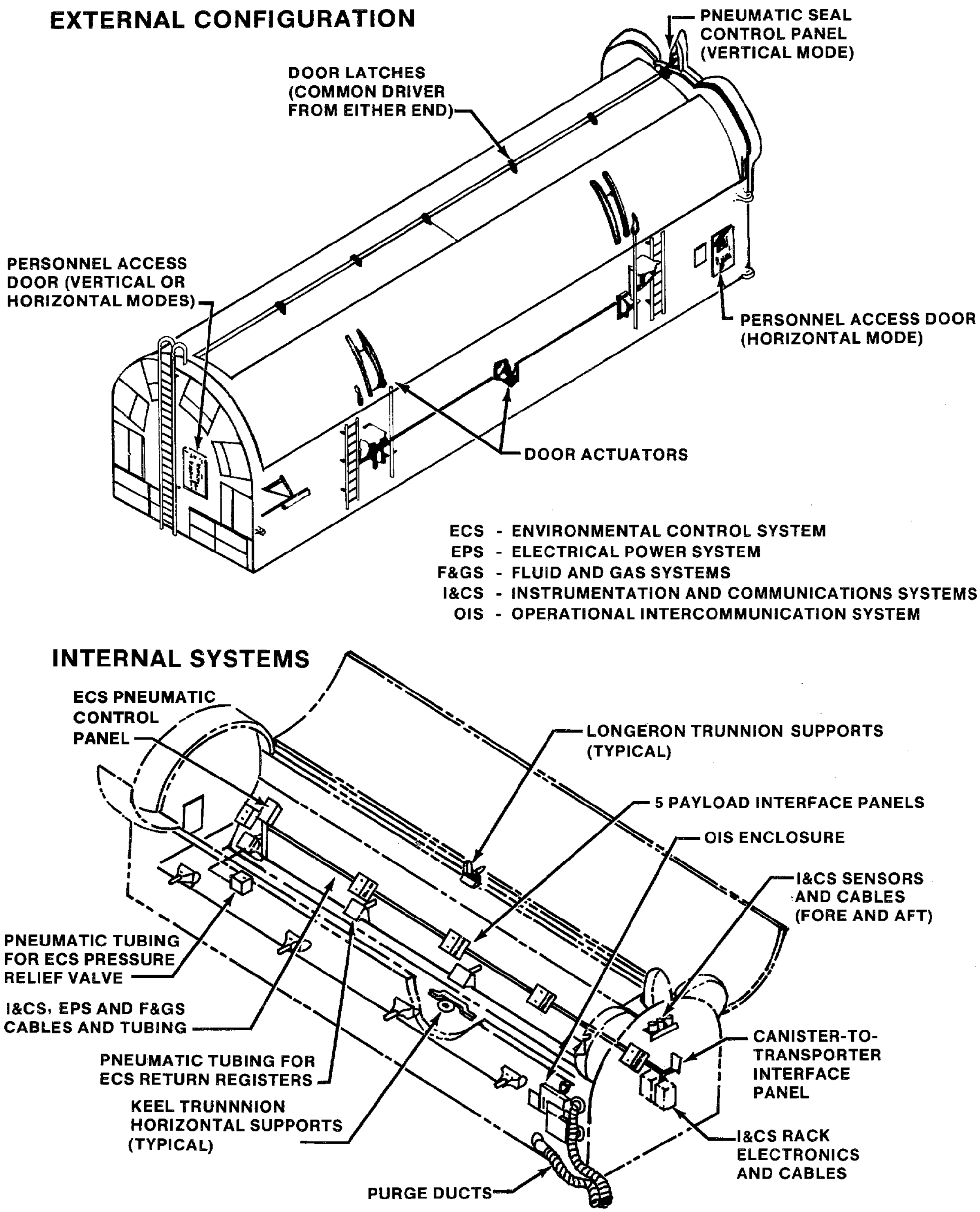
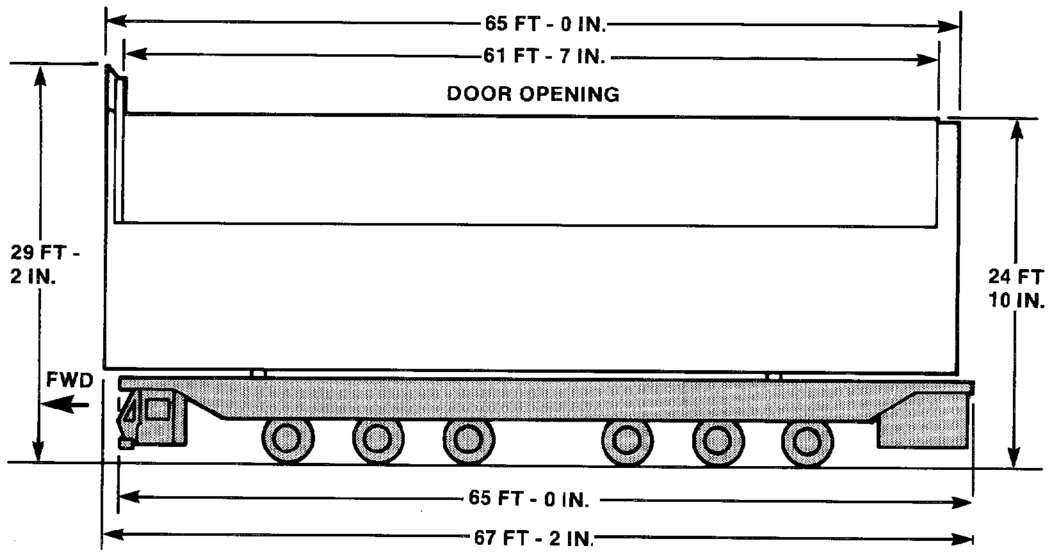


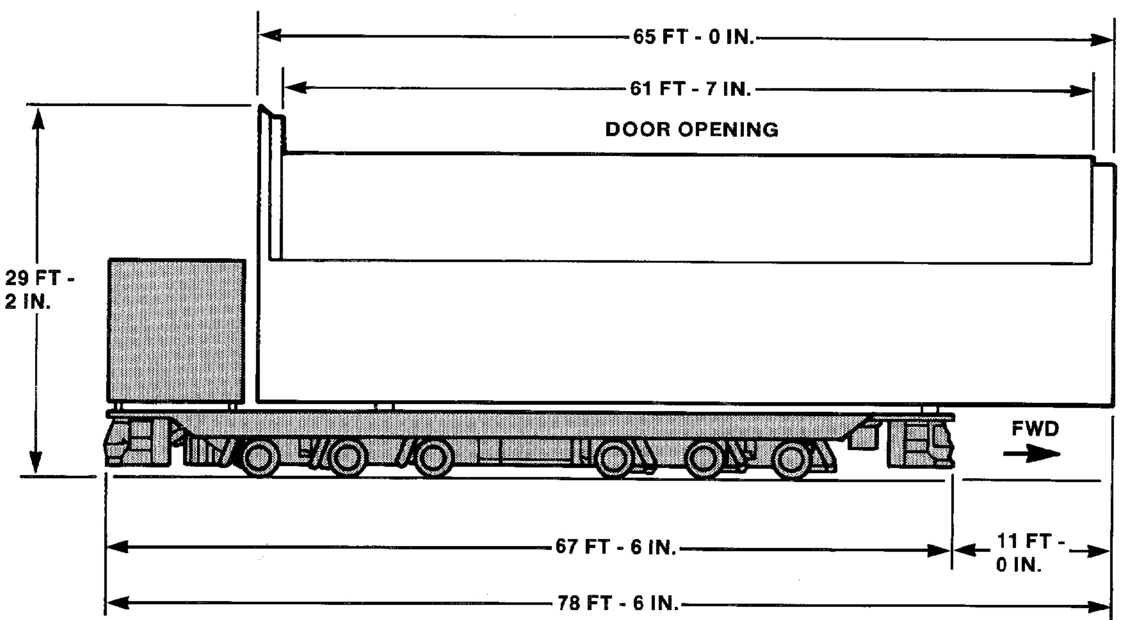
Figure 9-1.- Payload canister.

ISE 1ST SET TRANSPORTER/CANISTER ENVELOPE



STARBOARD SIDE ELEVATION

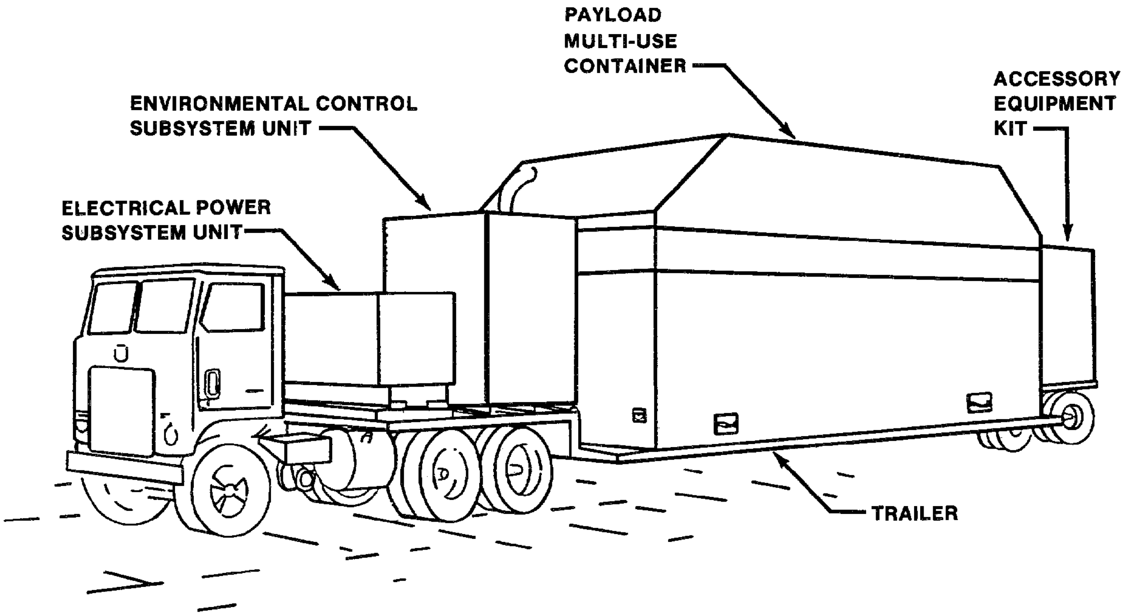
MMSE 2ND SET TRANSPORTER/CANISTER ENVELOPE



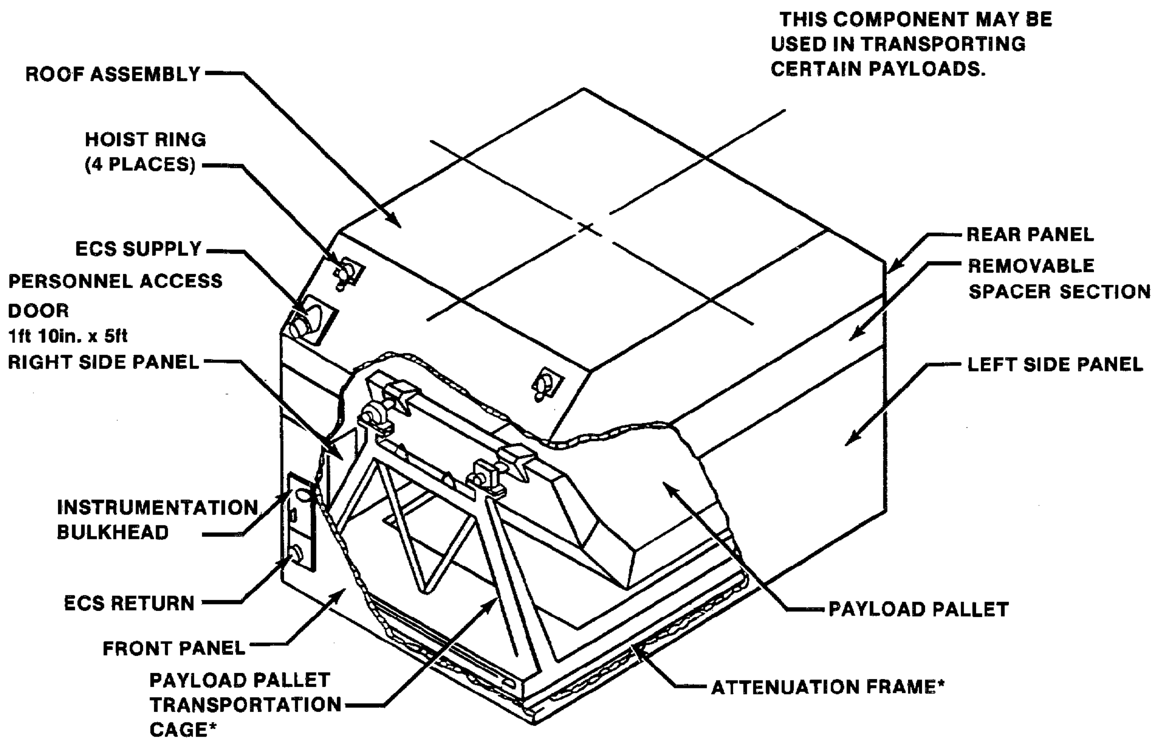
STARBOARD SIDE ELEVATION

MMSE - MULTIUSE MISSION SUPPORT EQUIPMENT

Figure 9-2.- Payload canister transporters.



PAYLOAD ENVIRONMENTAL TRANSPORTATION SYSTEM (PETS)



PETS MULTI-USE CONTAINER

Figure 9-3.- Payload environmental transportation system and multi-use carrier.

- Hydrocarbon content - 15 ppm of methane
- Pressure - 0.1 inch H_2O (maximum)
- ECS flow rate - 150 lbs/min (maximum)

When required, sensitive and highly sensitive cleaning processes will be performed prior to transport. These special cleaning requirements must be identified in the IP and in IP Annex 8.

b. Customers with payloads requiring special purges of payload elements may be accommodated by using K-bottles. Bottle regulators and flexible lines must be provided by the customer.

c. Recorded data and analyses can be provided by the following:

  - Self-contained acceleration detecting and recording units with internal triaxial accelerometers (4 each)
  - Payload-mountable acceleration detecting and recording instruments with external triaxial accelerometers (2 each)
  - Temperature/RH recorders (2 each)
  - Real-time monitor/alarm panels (2 each) which monitor out-of-tolerance conditions for any recorder

9.3 Payload Interface Verification Equipment

The purpose of this equipment is to simulate Space Shuttle functional interfaces for use in offline interface verification prior to installation of payloads into the payload bay. ICD 2-19001 describes all electrical and mechanical interfaces available to a payload. Cargo integration test equipment (CITE) use this interface control document (ICD) as a design requirements baseline document for electrical interfaces and services, but due to the unique physical configuration of this system, some electrical ICD requirements are compromised. These electrical ICD differences are listed in Table 9-I. The mechanical systems of the horizontal CITE stand (Figure 9-4) and the vertical payload handling device (VPHD) (Figure 9-5) are not high fidelity and do not exactly simulate Orbiter systems.

9.3.1 Horizontal Equipment and Support

Equipment in the Operations and Checkout (O&C) Building is described in the Space Station Processing Facility (SSPF) Standard Interface Document, Kennedy Space Center, 82K00760.

9.3.1.1 Cargo Integration Test Equipment

The horizontal CITE stand simulates Orbiter accommodations for all payload interfaces and is used to verify compatibility between payloads and simulated Orbiter mechanical, electrical, and electronic interfaces. Figure 9-6 shows the CITE block diagram. Closed-loop POCC interface tests are provided when required by the payload.

CITE testing includes an IVT, a mission sequence test (if appropriate), required payload element tests, and operations to validate planned online prelaunch and postflight operations, including emergency, contingency, and scrub/turnaround procedures.

The CITE avionics and cabling configuration is shown in Figure 9-6. CITE avionics are controlled by a flight-type GPC which executes flight software. The avionics and flight computer interface with CITE control room LPS equipment, which provides monitoring and control capability. Interfaces between a payload and the Orbiter are verified in the CITE stands with varying degrees of fidelity. Flight-type avionics form some of the electrical interfaces, while other interfaces are simulated. The basis for the interface design characteristics of interfaces which have been simulated is ICD 2-19001. A group of interfaces called “monitor only” provide only a passive impedance similar to that of the Orbiter. Pertinent payload signal characteristics are verified by CITE general purpose test equipment at the Orbiter-payload interfaces.

Table 9-II summarizes these three equipment categories. Figures 9-4, 9-5, and 9-7 illustrate the vertical CITE stand, control room, and equipment.

9.3.1.2 Electrical Accommodations

Both wideband (30 Hz to 4.5 MHz) and digital (RS-422 and RS-423, up to 256 kbps data rate (NRz)) transmission systems are available for telecommunications to and from the SSPF.

Table 9-I.- CITE AND ORBITER FUNCTIONAL SIMULATOR ICD 2-19001 DIFFERENCES

Item (Note 9)	ICD 2-19001	SS PF CITE	Vertical CITE	
			E. Cell	W. Cell
PI 2 Data Bus Rise/Fall Times (2)	100/260	Note 1	280/280	Note 1
PL 1 Data Bus Rise/Fall Times (2)	100/260	Note 1	300/300	270/280
PL 2 Data Bus Rise/Fall Times (2)	100/260	Note 1	Note 1	280/310
MDM Serial I/O Rise/Fall Times (2)	60 min- 250 max	Note 11	325/350	270/250
MDM Serial I/O Message Out Disc. (3)	0.1/1.0	Note 1	4/5	8/4
MDM Serial I/O Word Discrete (3)	0.1/1.0	Note 1	2/Note 1	Note 1
DC Ripple (Ded. Fuel Cell Mode) (4)	<100	100	120	120
DC Transient Impulse (5)	$3x10^{-4}$	$6x10^{-3}$	$6x10^{-3}$	$6x10^{-3}$
Mission Unique Wire Resistance (6) (SSP-SIP) (10)	<4	5.1	8.1	8.1
		See Note 7	See Note 8	See Note 8

Notes

1. Meets ICD 219001 specification
2. All rise/fall times units are in nanoseconds
3. All MDM serial I/O discrete units are in microseconds
4. DC ripple units are in millivolts
5. DC transient impulse units are in volt-seconds
6. Mission-unique roundtrip wire resistance is in ohms
7. Data bus measurements taken with a simulated GPC operating
8. Data bus measurements taken with an actual GPC operating
9. All measurements taken at the end of the SMCH cabling
10. SSP-SIP is standard switch panel - standard interface panel
11. MDM1 SIO-GNC-DATA=264/256, SENSOR-DATA Tr=256, MDM2 SIO-GNC-DATA=288/276, SENSOR-DATA=284/272, FF1-DATA=282.4/284

Table 9-II.- CITE INTERFACES AND EQUIPMENT

Flight-Type	Simulated	Monitor Only
GPC and MCDS PI PSP PDI PCMMU Standard switch panel MDMs CIE SMCH (cables & trays) Standard interface panels	28 Vdc 115/200 Vac 3 phase 400 Hz AFD Payload retention system control T-0 umbilical connections MTU Caution & warning Payload support fittings Payload safing	CCTV ACCU Scientific data

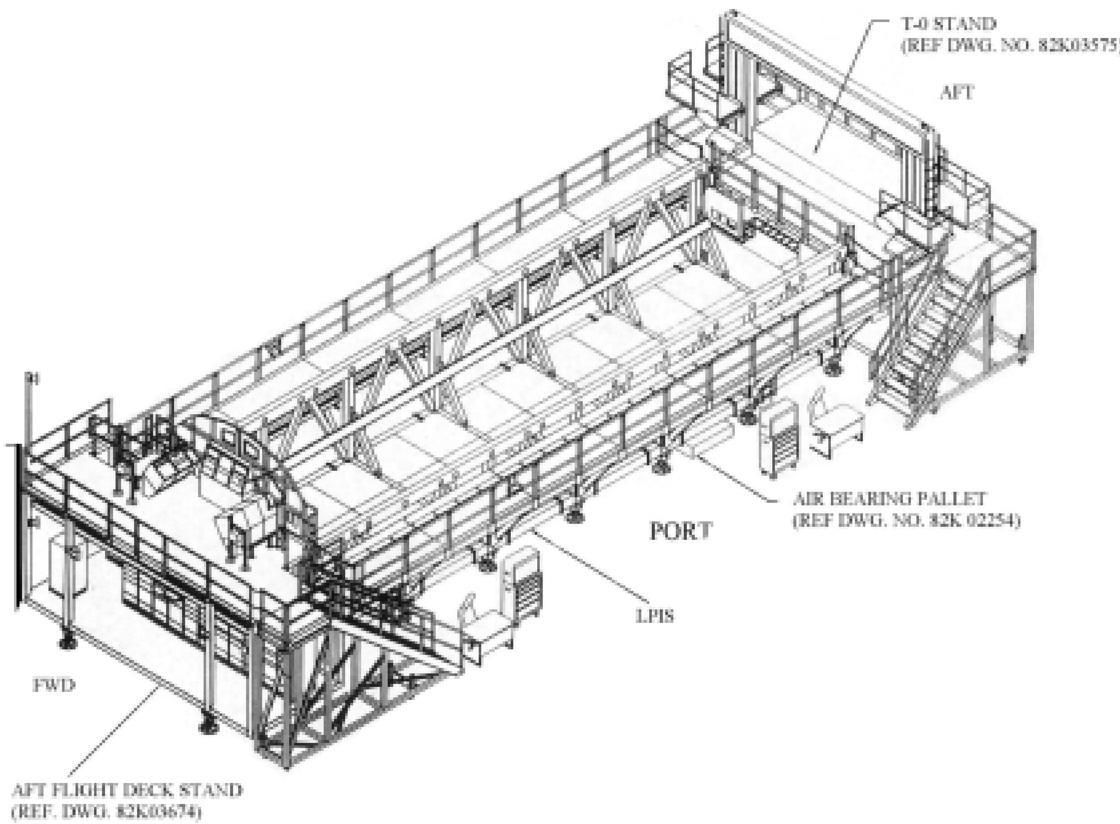
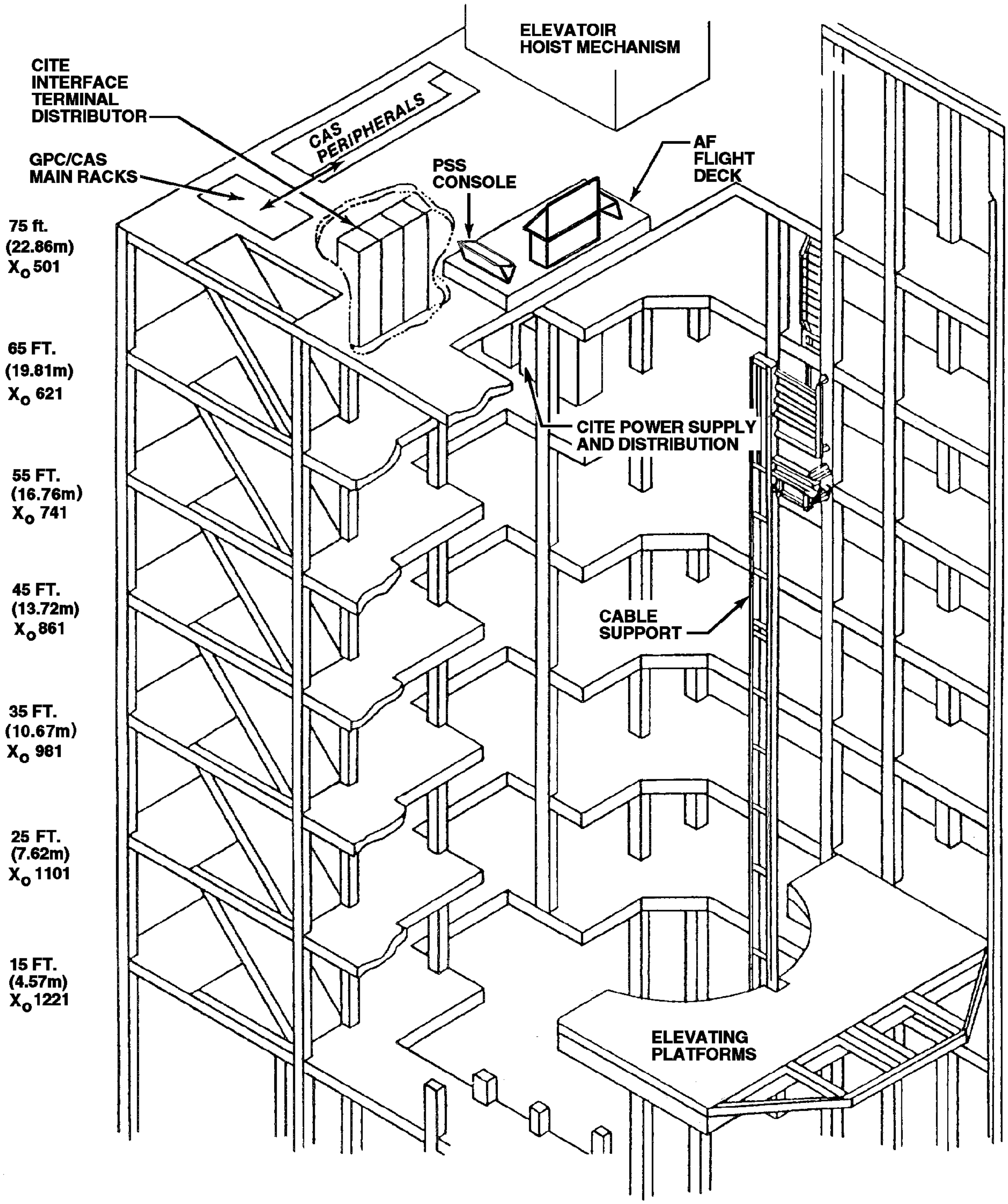


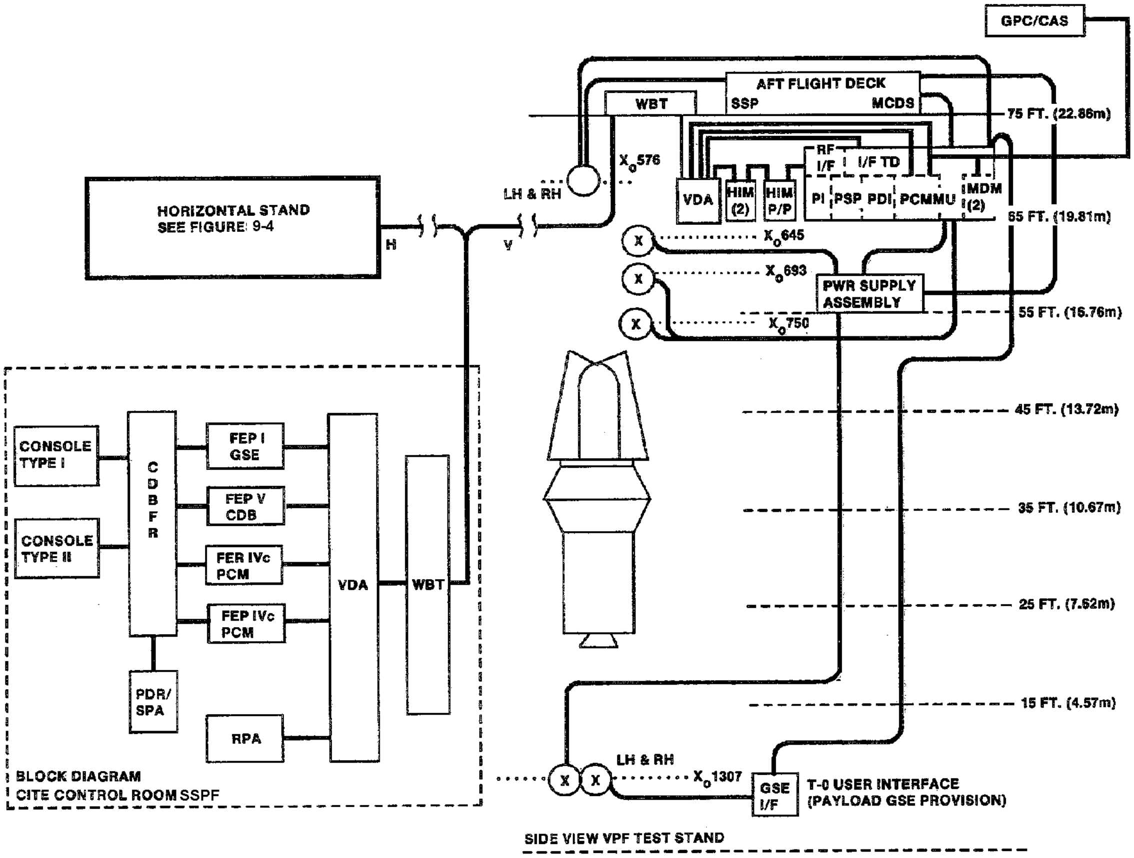
Figure 9-4.- Launch package integration stand.



GPC - GENERAL PURPOSE COMPUTER
CAS - CITE AUGMENTATION SYSTEM

CITE - CARGO INTEGRATION TEST EQUIPMENT
PSS - PAYLOAD SPECIALIST STATION

Figure 9-5.- Vertical CITE stand equipment location.



CAS - CITE AUGMENTATION SYSTEM
CDB - COMMON DFATA BUFFER
CDBFR - COMMON DATA BUFFER FIRING ROOM
FEP - FRONT END PROCESSOR
HIM - HARDWARE INTERFACE MODULE
GPC - GENERAL PURPOSE COMPUTER
MCDS - MULTIFUNCTION CATHODE RAY TUBE DISPLAY SYSTEM
MDM - MULTIPLEXER/DEMULTIPLEXER
O&C - OPERATIONS AND CHECKOUT BUILDING
PCM - PULSE CODE MODULATION
PDR/SPA - PROCESSED DATA RECORDER/SHARED PERIPHERAL AREA
RPA - RECORD AND PLAYBACK ASSEMBLY
TD - TERMINAL DISTRIBUTOR
SSP - STANDARD SWITCH PANEL
VDA - VIDEO DISTRIBUTION ASSEMBLY
VPF - VERTICAL PROCESSING FACILITY
WBT - WIDE-BAND TERMINAL
GSE - GROUND SUPPORT EQUIPMENT
PI - PAYLOAD INTERROGATOR
PSP - PAYLOAD SIGNAL PROCESSOR
PDI - PAYLOAD DATA INTERLEAVER
I/F - INTERFACE
CITE - CARGO INTEGRATION TEST EQUIPMENT

Figure 9-6.- CITE block diagram.

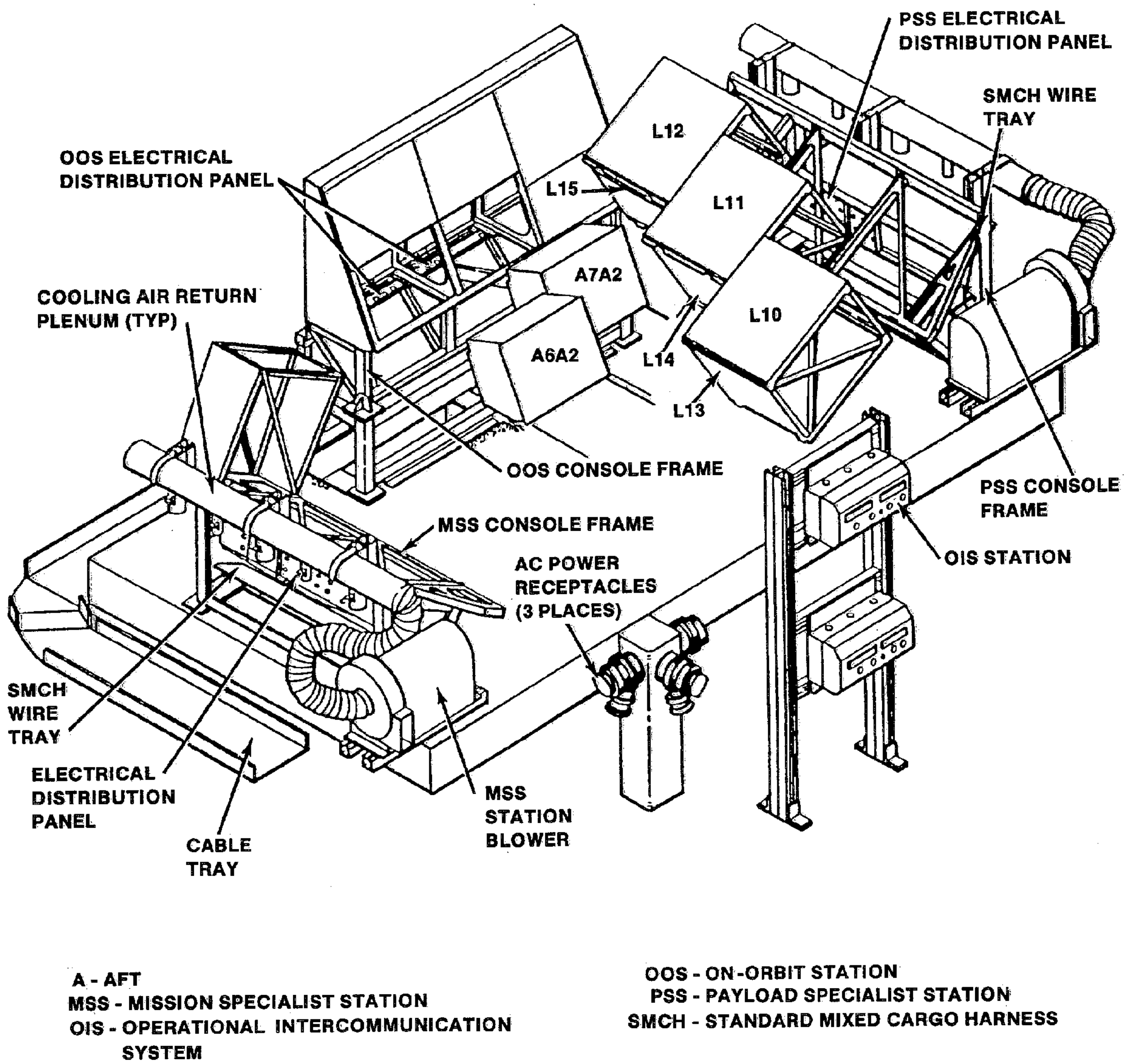


Figure 9-7.- Vertical CITE stand aft flight deck outfitting 75-ft (22.86-m) level.

9.3.1.3 Mechanical Accommodations

Mechanical equipment in the CITE stand includes an AFD structure, a forward Orbiter bulkhead assembly, an aft bulkhead, Orbiter-simulated cable trays, and a midbody assembly. The workstand deck provides basic access to the payload in the CITE stand.

The CITE stand payload support fittings can be adjusted along the stand rails to accommodate payload trunnions. These fittings provide the same interface as the Orbiter payload retention system. Reference Parts Lists, Payload Fitting/Support Rails CITE/Canister KSC, 79K20001, for further details.

Other provided capabilities are the Facility chilled water, compressed air stations, vent system, vacuum pumps, cooling servicers. For details reference Standard Interface Document (SID) KSC document 82K00760.

9.3.2 Vertical Equipment and Support

Equipment in the VPF is described in Vertical Processing Facility Standard Interface Document, Kennedy Space Center, 79K16210.

9.3.2.1 Cargo Integration Test Equipment

After the mechanical installation is completed in the VPHD, the payload is normally connected to the CITE for interface verification testing. ETE testing, if required, can be provided.

Vertical CITE capabilities to simulate Orbiter interfaces are identical to horizontal CITE as described in paragraph 9.3.1. The CITE also simulates MLP compartment 10A payload interfaces and the Orbiter T-0 umbilical disconnect.

9.3.2.2 Electrical Accommodations

An antenna system provides payload RF communication between the VPF and Merritt Island Launch Area (MILA) or the PPF. The interfacility RF system, from S-band to Ku-band, is described in detail in KSC HB-0004.0. Both wideband (30 Hz to 4.5 MHz) and digital (RS-422 and RS-423 up to 256 kbps data rate (NRz)) transmission systems are available for telecommunications to and from the VPF. A standalone power supply provides 28 Vdc to the payload for standalone operations.

9.3.2.3 Mechanical Accommodations

There are three overhead cranes in the VPF: two in the high-bay and one in the airlock. On the keel side, payload access is available from platforms located at Orbiter stations X_o1221 through X_o501 in 6-inch increments. On the payload side opposite the keel, access is available only in increments of 120 inches from station X_o1221 to X_o501. Mechanical equipment includes the following:

- The VPHD provides mechanical attachment points for the payload and can support single or multiple payload elements with a total weight of 65,000 pounds.

- The hypergol vent and drain system is available in the VPF to support contingency operations requiring the removal of fuel from a spacecraft/upper stage.

- The high/low pressure pneumatics system can provide high purity commodities He, N_2, and breathing air for the payload. A compressed air system is also available.

- A facility vacuum system is used for housekeeping activities during payload processing.

- An automatic contamination monitoring system continuously monitors particulates, temperature, and humidity in the VPF. This system is augmented by periodic testing of air samples and testing of witness plates located throughout the VPF.

- A payload environmental control system (ECS) can provide localized cooling to a payload.

9.4 Mission Control Center/Payload Operations Control Center Payload Ground Checkout and Prelaunch Operations Support

The role of Mission Control Center-Houston (MCC-H) in payload ground checkout and pre-launch operations support during Orbiter/ payload integration varies with the type of payload and associated payload support plans. Requests for MCC-H and POCC payload ground processing support will be negotiated with the SSP and documented in the IP.

9.4.1 Mission Control Center - Houston

MCC-H payload ground processing support is limited to POCC ETE, command, and data flow testing which require use of Space Shuttle or payload integration test equipment. The MCC-H role in these testing operations is defined in OMRSD. For payloads which can receive telemetry data only through Space Shuttle systems, a data flow verification test (DFVT) is provided by the SSP.

9.4.2 Payload Operations Control Center

All POCC ETE, command, and data flow testing which involves Space Shuttle or payload integration test equipment will be planned to preclude impact to SSP schedules.

9.5 Additional Payload Launch Site Accommodations

K-STSM 14.1 and facilities annexes provide the payload customer with official information on facilities available for payloads at the launch site, how to obtain unique facilities required for a specific payload, available launch site support services, and procedures for obtaining any unique services.

The SSP is not responsible for providing the ISS data required by KSC to perform ground testing and verification of ISS. ISS data will not be available on SSP products such as Shuttle Data Tapes and the Command and Data Annex-4. Exceptions will be given for hazardous commands, safety required inhibits, data elements having direct Shuttle interfaces such as the MPLMs, and control and monitoring of Shuttle/ISS hazardous conditions (e.g. unmanned ISS operations).

Acronyms and Abbreviations

10

A	aft
ac	alternating current
ACCU	audio central control unit
AFD	aft flight deck
AFDS	aft flight deck simulator
AFO	abort from orbit
AOA	abort once around
APU	auxiliary power unit
ASE	airborne support equipment
Btu/hr	British thermal unit per hour
C	Centigrade
C-band	3900 to 6200 megahertz
C&W	caution & warning
CCAFS	Cape Canaveral Air Force Station
CCTV	closed circuit television
c.g.	center of gravity
CIE	communications interface equipment
CIR	Cargo Integration Review
CITE	Cargo Integration Test Equipment
CWA	clean work area
D&C	display & control
dB	decibel(s)
dc	direct current
DFVT	data flow verification test
DOD	Department of Defense
EAFB	Edwards Air Force Base
ECLSS	environmental control life support system
ECS	environmental control system
EOM	end of mission
ET	external tank
ETE	End-to-end
EVA	extravehicular activity
F	Fahrenheit
FCE	flight crew equipment
FSS	Fixed Service Structure
ft	foot, feet
g	gravity
GHA	good housekeeping area
GHe	gaseous helium
GHz	gigahertz
GN_2	gaseous nitrogen
GPC	general purpose computer
GSE	ground support equipment
HC	hydrocarbons
HEPA	high efficiency particulate air
HVAC	heating, ventilation, and air conditioning
Hz	hertz (cycles per second)
I/O	input/output
ICD	Interface Control Document
IRIG-B	Interrange Instrumentation Group B
IUS	Inertial Upper Stage
IVT	interface verification test
JSC	Lyndon B. Johnson Space Center
kbps	kilobits per second
kg	kilogram(s)
kg/cm^2	kilograms per square centimeter
kg/m^2	kilograms per square meter
kg/min	kilograms per minute
kJ/hr	kilojoules per hour
KSC	John F. Kennedy Space Center
Ku-band	10.9 to 36 gigahertz per second
kVA	kilovoltampere(s)
L-	launch minus
lbs/min	pounds per minute
lb	pound(s)
lb/ft^2	pounds per square foot
IP	Integration Plan
LC	Launch Complex
LCC	Launch Control Center
LPAC	localized payload air conditioning system
LPS	launch processing system
LSFR	Launch Site Flow Review
LSSM	launch site support manager
m	meter(s)
MCC-H	Mission Control Center-Houston
MCDS	multifunction CRT display system

MDD	mate/demate device
MDM	multiplexer/demultiplexer
MILA	Merritt Island Launch Area
MIN	minimum
MLP	mobile launch platform
MTU	master timing unit
MVAK	module vertical access kit
N_2	nitrogen
NASA	National Aeronautics and Space Administration
no.	number
NRz	non return to zero
NVR	nonvolatile residue
O&C	Operations and Checkout Building
OFS	Orbiter functional simulator
OIS	operational intercommunication system
OMRSD	Operations and Maintenance Requirements and Specifications Document (NSTS 08171)
OMI	Operations and Maintenance Instruction
OPF	Orbiter Processing Facility
OTS	Orbiter transportation system
PCMMU	pulse code modulation master unit
PCR	Payload Changeout Room
PDI	payload data interleaver
PGHM	payload ground handling mechanism
PI	payload interrogator
PIP	payload integration plan
PL	payload
POCC	Payload Operations Control Center
PPF	Payload Processing Facility
ppm	parts per million
PPU	portable purge unit
PRR	Payload Readiness Review
PRSD	power reactant storage distribution
psia	pounds per square inch absolute
psig	pounds per square inch gauge
PSP	payload signal processor
PTCR	Pad Terminal Connection Room
RF	radio frequency
RH	right hand
RMS	remote manipulator system
RSS	Rotating Service Structure
RTLS	return to launch site
S-band	1.55 to 5.2 gigahertz per second
SCA	Shuttle carrier aircraft
SID	standard interface document
SIP	standard interface panel
SMAB	Solid Motor Assembly Building
SMCH	standard mixed cargo harness
SRB	solid rocket booster
SSP	Space Shuttle Program
T-0	time minus zero
TAL	transatlantic abort landing
TDRS	Tracking and Data Relay Satellite
UMPS	up mission processing start
V	volt(s), vertical
Vac	volts alternating current
VAB	Vehicle Assembly Building
Vdc	volts direct current
VPF	Vertical Processing Facility
VPHD	vertical payload handling device
W	width
WSSH	White Sands Space Harbor
X-band	5.2 to 10.09 gigahertz per second

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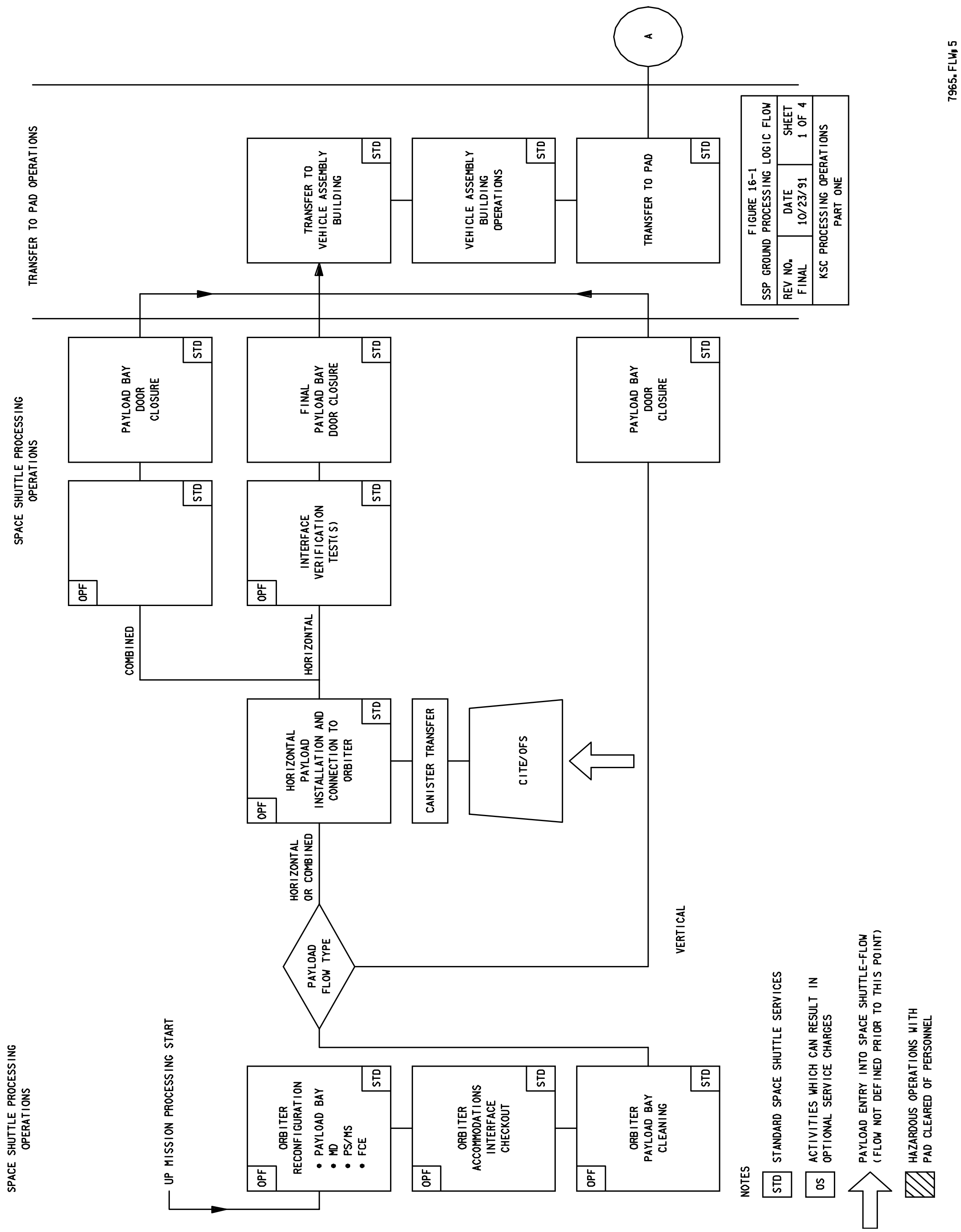

Figure 12-1.- SSP ground processing logic flow.

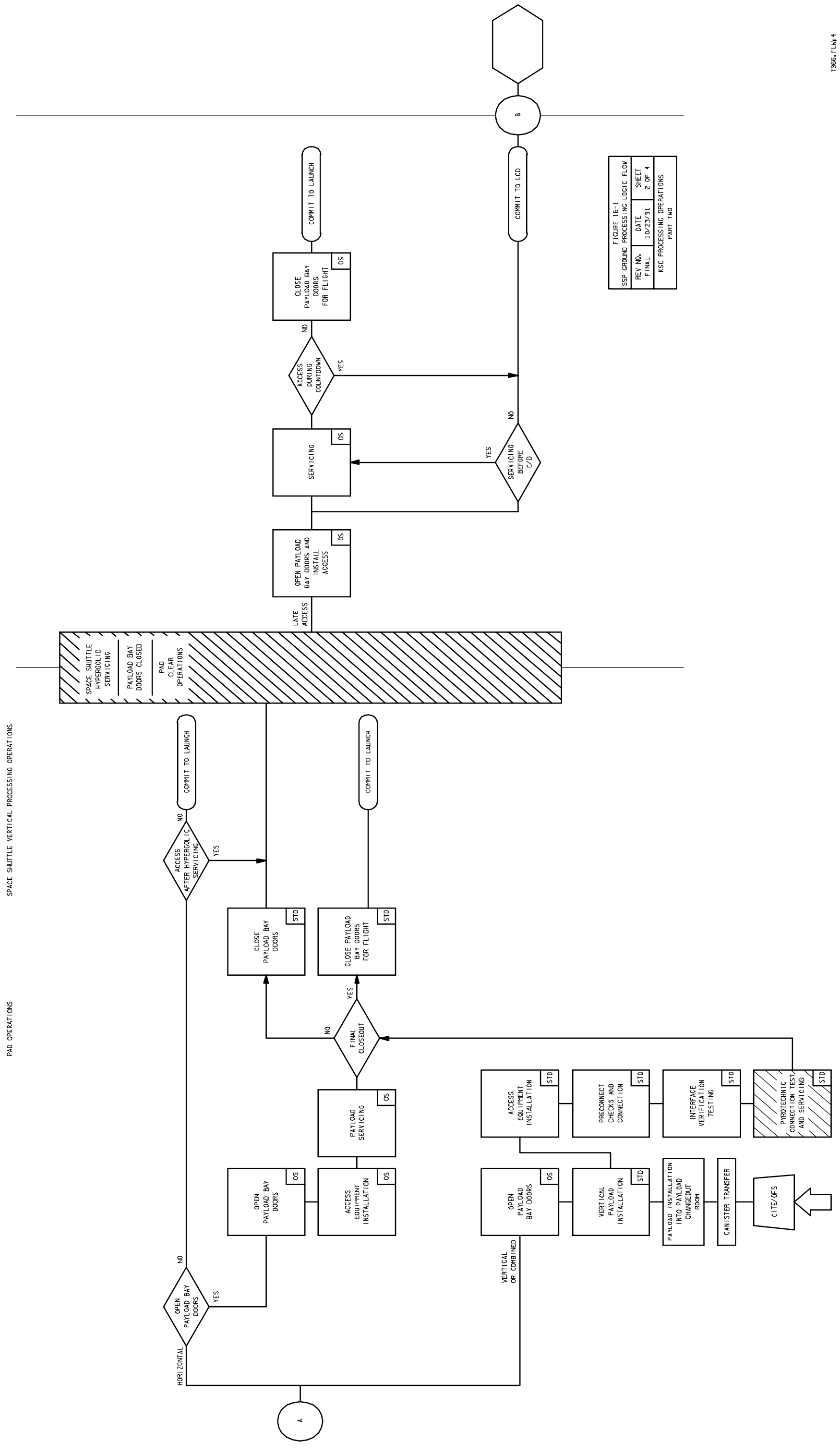

Figure 12-1.- (continued).

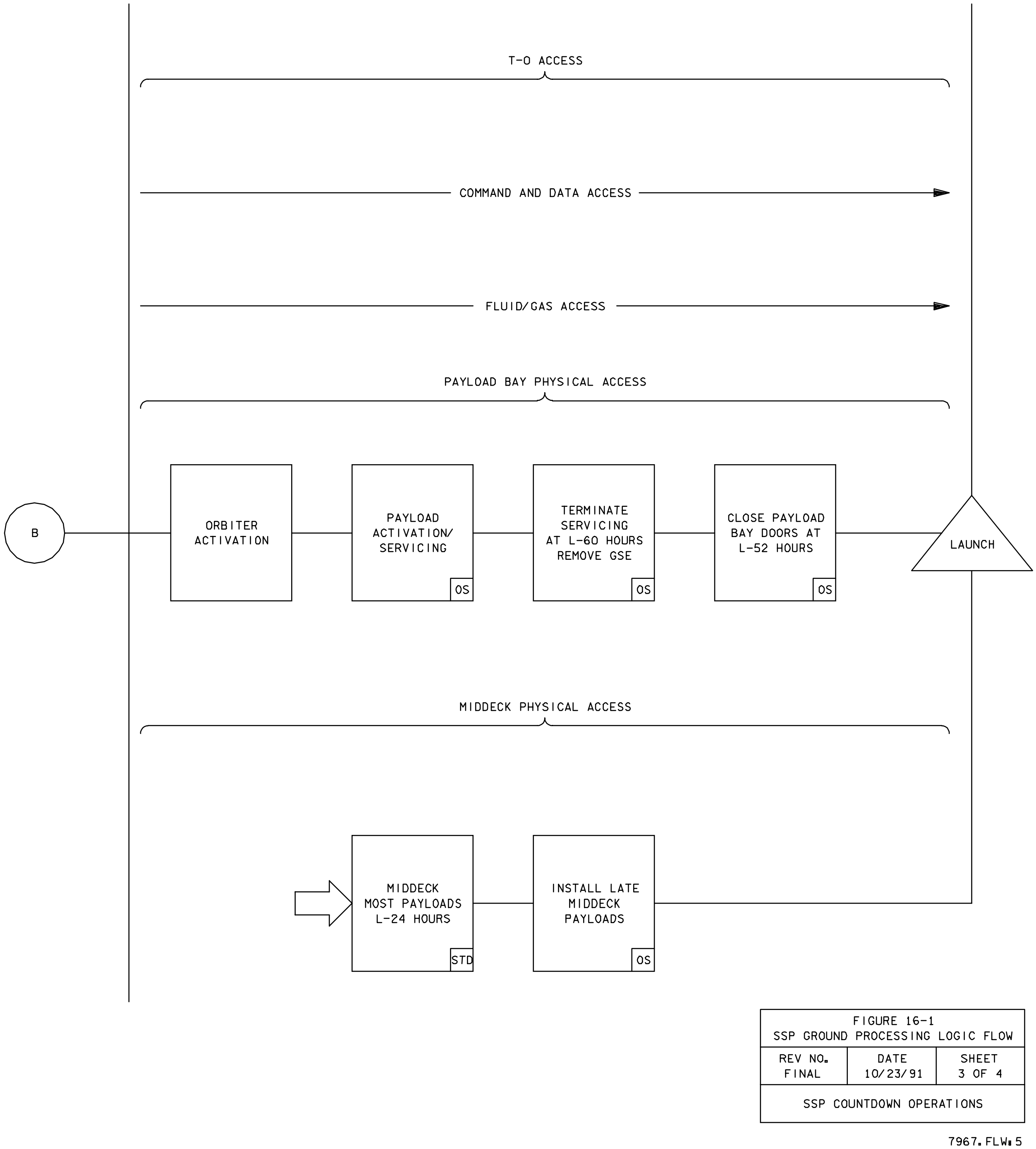

Figure 12-1.- (continued).

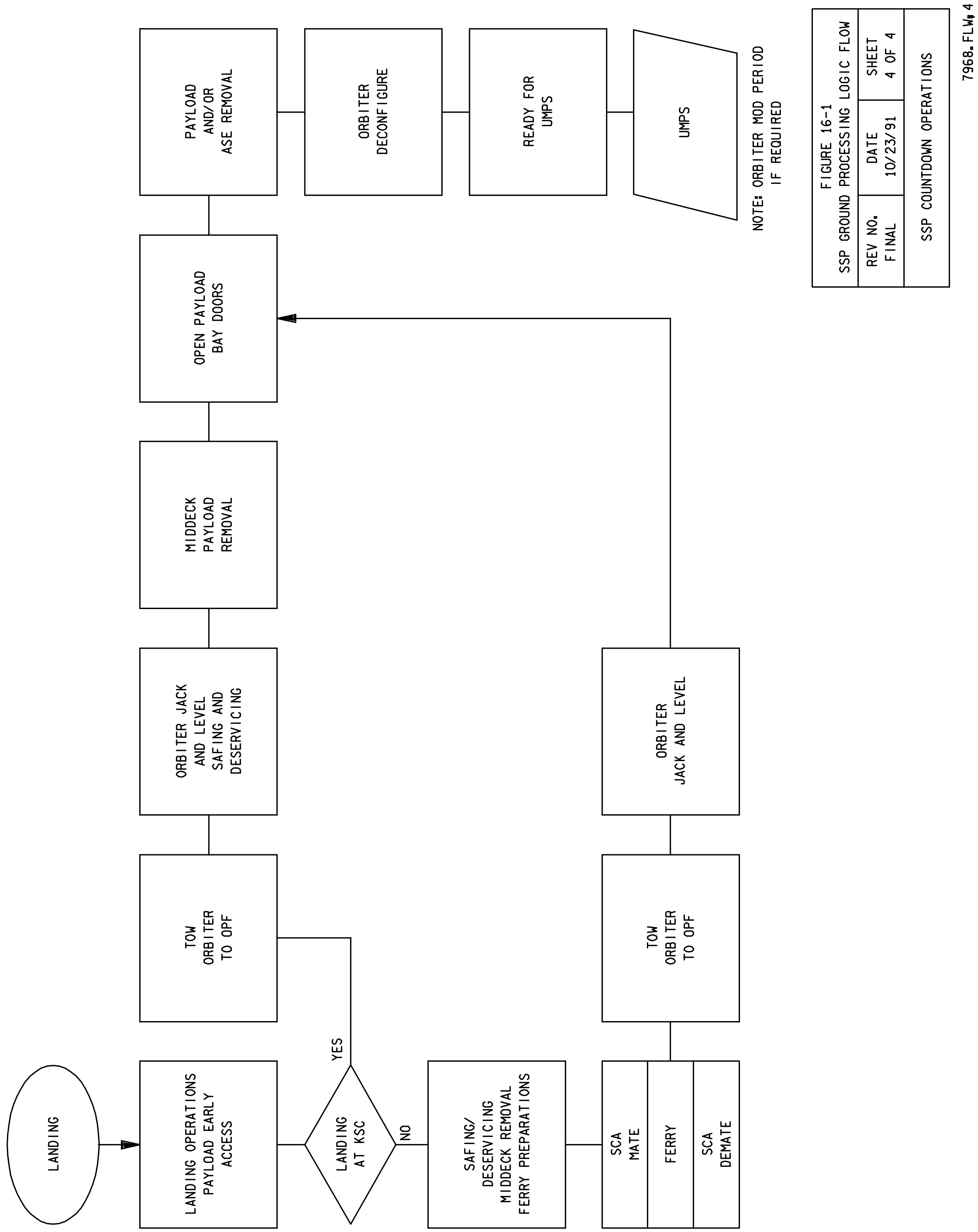

Figure 12-1.- (concluded).